The FOUNDRY

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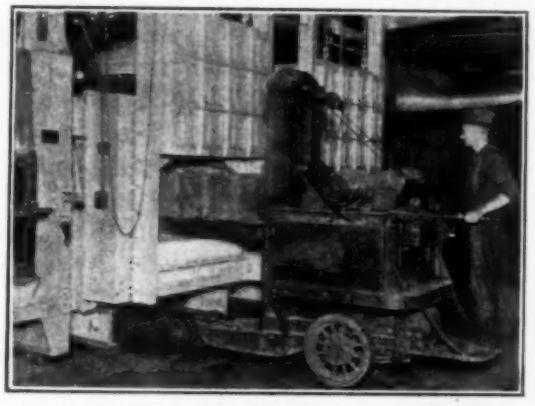
Castings Hold Castings in Annealing Process

CHANGING the physical properties of malleable, steel and gray iron castings to increase the commercial value necessitates a large tonnage of iron being poured annually in annealing boxes, pots and pans. The high temperatures reached in the annealing process and the constant heating and cooling cycles make the life of the ordinary annealing pot relatively short. If the pot survives the first two or three heats without cracking, due to internal stresses in the metal,



Cast Annealing Boxes Last Through Repeated Trips to the Oven

its life depends on the destructive effect of oxidation. The average life of the annealing pot is said by some authorities to lie somewhere between 15 and 25 trips through the furnace, although under favorable conditions the pot may survive a larger number of heats. The life of the annealing pot also depends on the composition of the metal annealed, since the pot used in annealing gray iron castings will last longer than one used in the malleable shop. Annealing boxes, pots and pans are made in the foundry from gray iron, special white iron and steel. While Reaumur discussed annealing as early as 1722, the use of cast iron annealing boxes was not recorded until in 1829 when Thomas Morgan, Ruperra, England used them to anneal tin plates.

Find Where Castings Can Be Sold.

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Artist's Skill Demanded in

Making Heroic Statuary

TECHNIQUE employed in molding and casting statuary and other objects of art either in base or precious metal, has changed but little since Aaron, the first master molder of record, cast a golden calf for the children of Israel. Quite true, modern commentators see nothing in this story but an allegorical reference to wealth, which through all ages and to all people has been an object of more or less adoration and reverence.

Even if this famous ancient golden calf was a myth, still sufficient authentic evidence remains to prove that metal has been cast into statuary and other ornamental shapes from an exceedingly early period in the history of mankind. Bronze bells and other castings have been found in China bearing marks which indicate they were made 2000 years before the Christian era. A certain amount of mystery surrounds the ultimate fate of the immense columns and other bronze castings which Solomon had made for the temple, but the story of their production is too detailed and perfect to permit any doubt of their one time existence. Without stretching the imagination too far one might hazard a guess that most of the bronze found its way to Rome after the imperial legions had sacked and ravished Jerusalem. Cunning artificers were required to fashion those famous castings, but any barbarian could smash them so that they might be loaded on the dusty camel trains and driven with all the other spoil of war either overland through Asia Minor and Greece or down to one of the great Mediterranean ports and thence by galley to the sovereign city on the seven hills.

This theory may account to some extent for the prominent place taken by Italy in the field of artistic metal work in early ages, a place by the way maintained up to the present. A large quantity of available bronze scrap, large for the time and place, turned the eyes of artists to that material as a medium for expressing their creative genius.

The extent to which artists were skilled in various lines may be inferred from the autobiography of one of the most notable of his time, Benvenuto Cellini, who was a sculptor, a painter, a jeweler, an engraver and a highly skilled molder and melter. In addition —which of course has no bearing on the present discussion, but is introduced merely to throw a side light on the amazing vitality and wide range of accomplishment of the man— he was a gambler, a swordsman, a gentleman of fashion and a traveler with an irresistible attraction for the ladies. Taking into account the time devoted to his fights and his amours, one is amazed not at the extent of the collection of bronze and other masterpieces he accomplished, but at the idea that he found time

Fig. 1—Large bronze group commemorating the coming of the white man to the region of the Great Lakes in North America. It has been erected in front of Harrison Technical high school on Marshall boulevard, Chicago

By

Pat Dwyer

to execute the simplest of them.

Cellini and those who followed him for many years required no outside assistance. Every step in the process from the conception of the image to the final unveiling of the completed figure represented the effort of one man. His workshop frequently served the double purpose of a dwelling place and a factory.

Actual methods of producing statuary and other somewhat related objects in bronze are almost the same as they were in the time of Aaron, Solomon or Cellini, with the single exception that one man's work now is divided among many men. Modern traveling cranes take the place of the old gin pole and pulley blocks. Electricity, oil, gas and coke have replaced charcoal as a melting medium. In fact, the art has become so commercialized in recent years that it is no longer mysterious—to those on the inside.

Fig. 2—Marquette group as it appeared on the floor of the erection shop. Total height 13 feet 1 inch. Plinth 11 feet 8 inches x 6 feet 1½ inches

To the vast army on the outside, including the majority of foundrymen, the process still is wrapped in mystery. This is a natural state of affairs in view of the fact that probably not more than a dozen shops in this country out of a total of nearly 7000, engage in the production of this class of castings. None of these shops is large as the term usually is understood and none is engaged exclusively in the production of statuary. Most of these shops limit their activities to ornamental castings which of course include statues, but several handle a general line of nonferrous castings to an extent of 50 per cent or more of their capacity.

Among this comparatively small group, the bronze foundry of the Gorham Co., Providence, R. I., stands out prominently through a long and successful career and through the long list of notable castings that have been turned out. A silver statue of Columbus slightly over life size and claimed to be the largest figure ever formed from this precious metal, was made in this plant shortly after it was built and was exhibited at the World's fair in Chicago. After it served its purpose, the silver figure was scrapped and remelted. A bronze replica of the same figure still stands at a V-shaped street intersection near the Gorham plant, peering eagerly forward as the explorer probably peered on many occasions from the deck of the SANTA MARIA, praying for a sight of the western land before his mutinous crew could swing the galleon around and head once more for the East and freedom.

By a curious coincidence one of the largest bronzes turned out recently by this firm also was sent to Chicago where it is mounted on a granite pedestal in front of Harrison technical high school on Marshall boulevard at Twenty-fourth street. This heroic group shown in Fig. 1 was designed by the famous New York sculptor H. A. MacNeil and is shown in Fig. 2 as it appeared on the floor of the shop where it was finished and assembled. The group measures 13 feet from top to bottom and rests on a plinth 6 x 12 feet. Total weight of the group is 10,000 pounds.

An appreciation of the size of the group may be had by comparing the figures with those of the workmen engaged in administering a few minor finishing touches. No picture can convey the effect produced on the mind by a closeup view. No mere reproduction in black and white can

Fig. 3—One of the rooms in the drafting and modeling department where the various designs first begin to take tangible form

cause little involuntary half hysterical nervous thrills to ruffle one's equanimity after the manner in which a placid sheet of water is ruffled by a vagrant breeze. The gigantic figures heighten the illusion of majesty, power and indomitable will personified by the two white men, among the first to penetrate the continent 1000 miles from the sea.

The attitude of Pere Marquette, crucifix held aloft in one hand and the other stretched forth in peace and supplication is typical of the missionary spirit which carried him through privation and hardship and held him steadfast to the cause he served. He is supported on one side by a friendly Indian and on the other by Louis Joliet, one time doughty chevalier of old France, but now the intrepid explorer of a new land. Dressed in the buckskin shirt of the wilderness held in at the waist by the *ceinture fleche* he is a grand figure of a man from the *bottes sauvage* on his confident feet to the fur cap on his bold and swarthy head.

Large One-Piece Casting

For convenience in handling, the group was cast in several sections and afterward assembled with the joints so cleverly concealed that they cannot be detected except by the most minute examination and with that examination conducted by a person familiar with this form of construction. On account of railroad limitations the head of Marquette was not attached permanently until the group was assembled in Chicago.

A large bas-relief panel may be noted in the background of the illustration Fig. 2. This was designed by a noted Boston sculptor, Bashka Paeff, for the state of Maine memorial to the soldiers who marched away from the Pine Tree state during the World war, but who failed to return. This panel, 8 x 11 feet and 3000 pounds in weight, was cast in one piece, a notable achievement considering the area and the thickness of metal.

Before taking up in detail the various steps in the process of producing these castings a description of the plant where the work is handled and the equipment required for its successful prosecution will be of interest.

According to a description which appeared in THE FOUNDRY December, 1896, the original brick foundry building was 40 x 100 feet, 25 feet high, with a monitor roof and with ample lighting facilities through the sides of the monitor and double windows along the sides and ends of the building. Two hand-power jib cranes were provided for handling the heavy molds. The metal was melted in a battery of 12 coke-fired, crucible, pit furnaces served by two radial arms, each one supporting a chain block.

Used Oil Fuel

Ample oven capacity was provided and what is more remarkable for that period, oil was used for fuel. That this innovation was regarded in an experimental light is indicated by the fact that coal-burning fireplaces were built in the ovens, as the writer naively remarks in case of possible defect in the oil burners.

In 1906 the foundry practically was rebuilt and doubled in length and width. A row of steel columns in the center divides the shop into two bays longitudinally and incidentally supports one side of the runway for a 25-ton traveling crane made by the Niles Crane Corp., Philadelphia. This crane has taken the place of the jib cranes and covers the bay where all the larger molds are made. The second bay is equipped with benches

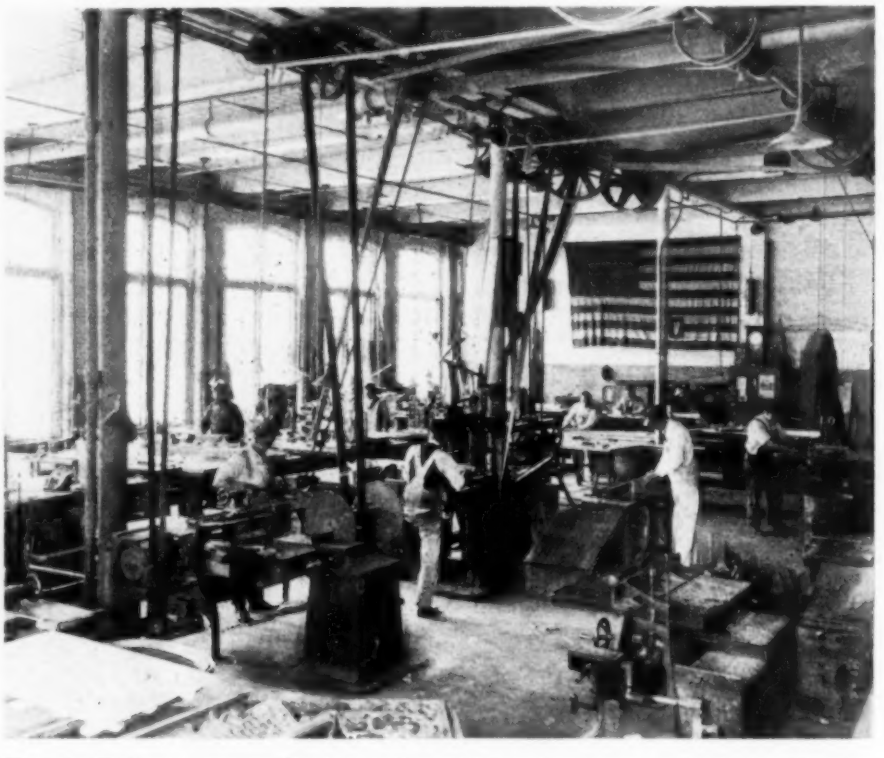

Fig. 4—Patterns are made in wood, metal, plaster, wax or in a combination of two or more of these materials in a well equipped pattern shop

and other necessary conveniences for the production of the plain and complicated light castings produced in this part of the foundry.

Two additional bronze casting departments are maintained in buildings which adjoin the main foundry. In one a wide variety of castings is made in green sand molds. In the other, small ornamental castings are made in plaster molds. Each department has its own melting equipment.

Melting Equipment

A battery of 1 large and 5 small, oil-fired, pit furnaces still is maintained on one side of the shop in which metal is melted in 60 to 70-pound crucibles. These are used for special heats, for short orders and under many other circumstances connected with the production of an extremely wide and interesting line of small castings. Most of the metal for the daily melt in the heavy section of the foundry is melted in a battery of 4 open-flame oil-burning furnaces made by the Monarch Engineering & Mfg. Co., Baltimore. They occupy a space almost in the center of the building and in such a position that the ladles that serve them may be handled by the traveling crane. Two of these furnaces have a melting capacity of 1 ton each to a charge. The other two furnaces are smaller. Each one is designed to hold ½-ton. This gives a combined melting capacity of 6000 pounds at one time. More than sufficient to meet the requirements of any single piece presented up to the present either as a unit or as part of a group.

Fig. 6—General view in the main assembly room where all kinds of ornamental bronze work is carried out. Sheet and other forms of rolled product enter extensively into many of the contracts

Many finished pieces of work have weighed over 6000 pounds, but expediency in making the molds and in shipping and assembling the castings, rather than lack of melting capacity, has suggested the advisability of dividing large pieces into several sections. This method was taken up in greater detail in an article devoted exclusively to the methods employed in making the bronze figure of *The Fisherman*, recently erected in the city of Glouscester, Mass. This appeared in THE FOUNDRY for April 1, 1927.

With the exception of two small ovens where small molds and cores are dried by steam coils in the light work section of the foundry, all other drying and heating operations depend on oil fuel. It is used in the large ovens, the melting furnaces, and in torches maintained at certain points near the furnaces for drying and heating the ladles before the metal is poured into them from the furnaces. Large hoods over the furnace battery conduct smoke, gas and heat away from the vicinity and discharge through suitable stacks projecting through the roof.

All the molds are dried with the exception of those referred to previously which are made in the green-sand foundry annex. The small sand molds are dried in two ovens located outside the wall on the light work side of the foundry. The ovens are equipped with recording pyrometers which enable the night attendant to raise the temperature to a maximum of 500 degrees Fahr., and hold it at that point for varying periods, depending on the general character of the molds and the instructions left for his guidance.

Make Large Molds

Large molds made in the other main bay of the foundry are dried in 3 car-type ovens 8 x 10 x 14 feet with doors located in the side wall of the building and with tracks extending well out on the main floor where the loads may be handled by the traveling crane. The time for drying the molds varies from one to several days, depending on the size and thickness of the body of sand. The French sand from which the molds are made has the peculiar property of drying almost as hard and firm as a brick through simple exposure to

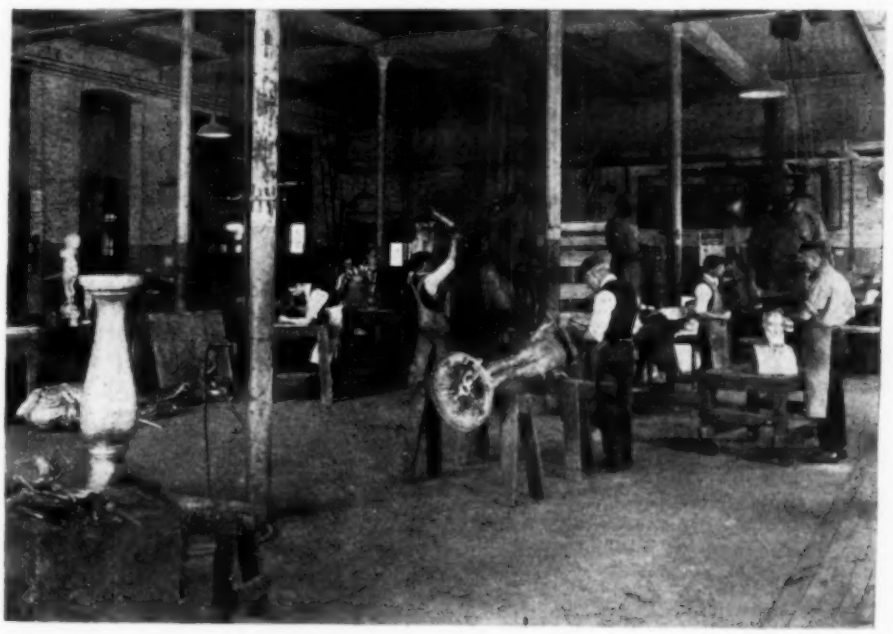

Fig. 5—A group of highly skilled workmen chip the castings and administer the finishing touches in a department where the larger figures are assembled from two or more separate parts

the atmosphere. However, on account of the immense area covered and the minimum thickness of metal in these castings, the last vestige of moisture must be driven from the sand so that nothing may be present to prevent the metal from filling the mold in minutest detail.

Sand Is Mixed

The greater part of the sand used in this foundry is imported from France. Apparently and so far as available records indicate, no other sand has the peculiar characteristics which render this sand so suitable for the production of intricate and ornamental castings. It possesses the contradictory features of extreme fineness with maximum permeability. It may, in fact it must be rammed almost as hard as a brick and yet the metal will lie as quietly against it as it lies against ordinary molding sand when it has been rammed to a degree of density where an impression easily may be made on the surface with the fingers. While in the green state various bodies of sand forming the mold or core may be handled as readily as so many sun dried bricks.

For economy under certain conditions old and new sand is mixed in varying proportions. The usual proportion is 2 parts new sand to 1 part old sand. New sand exclusively is used for the facing and cores on the large, intricate molds. Old sand in varying proportions is used in the mixtures for lighter and plainer molds. Finally the sand is used to renew the heaps in the green sand department.

After the castings have been removed from the dried molds, the caked sand is dumped into a pit from which it is lifted by a bucket conveyor and passed through a coal breaker made by the Jeffrey Mfg. Co., Columbus, O. Molding sand probably was the material farthest from the mind of man who designed this machine, yet in this foundry it serves the purpose just as satisfactorily as thousands of its counterparts perform their legitimate function in pulverizing coal.

Old and new sand in required proportions, or all new sand as the case may be, are mixed thoroughly in a 6-foot, muller-type mixer made by the National Engineering Co., Chicago. Later, it is passed through a No. 8 riddle and collected in barrels or boxes and conveyed to the various molds in process of construction.

Dust, smoke, wide variations in temperature at different periods and other more or less unpleasant features connected with the casting industry are conspicuous by their absence in the Gorham foundry. The brick and steel building with clean windows is whitewashed on the inside and heated in cold weather by long steam coils attached to the walls. The smooth, concrete floor easily is kept clean, particularly on the side where the larger castings are made. On account of the great number of parts into which the mold usually is divided, a generous space is allotted to each. Thus there is no crowding, no confusion and no loose sand lying around after the flask has been filled.

Highly Skilled Men

In this respect the methods pursued in this foundry present marked contrast to those of the ordinary foundry and differ radically from those in use in the specialty or production foundries. It is readily apparent that a much higher degree of skill, training, intelligence and all around knowledge is required on the part of a molder who may spend a month on a mold 4 x 6 feet, than is required of the man who stands in line beside a conveyor and repeats a single action all day long. Also, it is apparent that the weight of the casting is no criterion of the molder's skill and ability. Conceivably one man might not have 1000 pounds of castings to his credit for a month's work. In the same space of time the pro rata share of a second man working in an iron foundry under different conditions may amount to 30 tons.

Work Is Divided

In the olden times one man designed a certain casting. He made the drawing and the model and then in succession he made the full size pattern, all the rigging required, including the skeleton or arbor for the inside, and the flask or frame for the outside. Then he made the mold and the core, dried them, reassembled them, secured them firmly together. Afterward, he melted the metal, poured it into the mold and after it had cooled sufficiently he stripped away the mold, removed the casting and applied the necessary finishing touches.

Under modern conditions all these items may be covered in the same plant, but they are divided among many men. With the single exception of statuary figures which are modeled in clay by the sculptor at his studio, all the steps incident to the production of castings and also ornamental bronze work formed from rolled shapes, are covered in the bronze foundry division of the Gorham Co.

A customer may or may not have a tangible idea of what he wants. If he knows exactly what he wants, a drawing and a pattern are made in succession, taken into the foundry where a mold is made and poured. If the customer, for example, wants a bronze door or a fountain, and if the only nebulous idea in his mind is that it must occupy a definite amount of space in a given location,

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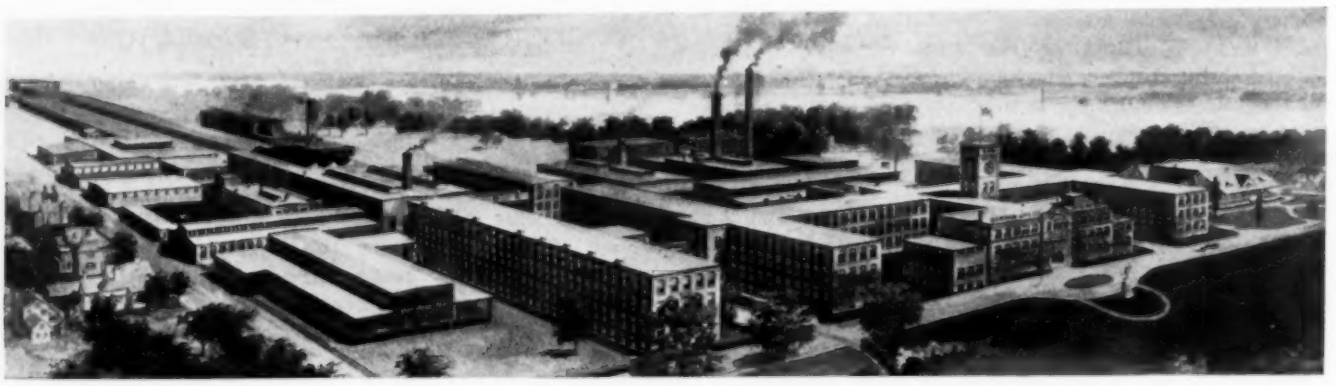


Fig. 7—General view of the wide spread plant of the Gorham Co., Providence, R. I. A beautiful lawn slopes down from the driveway in front of the group of buildings to the enclosed tracks of the New York, New Haven & Hartford railroad. The bronze foundry division occupies the buildings shown at the back and to the extreme left

Nickel Changes Properties of Gray Cast Iron-II

By D. M. Houston

IT IS the sincere desire of every foundryman to produce castings that are acceptable to the machine shop. If the foundry can produce a metal sufficiently dense and strong to meet the requirements of the designing engineer and at the same time permit the machine shop to speed up its machines or use other means of rapid machining, the economic value reflects itself in a reduction of machine shop costs.

Fig. 6 shows a cut gears made from the following analysis: Silicon, 1.50 to 1.60; sulphur, under 0.10; phosphorus, 0.40 to 0.50; manganese, 0.60 to 0.70 per cent.

The average amount of time per gear covering a period of months, including the amount spent in castings which were scrapped due to internal shrinkage and hard castings amounted to 9 hours machine shop time.

A change in composition to: Silicon, 1.20 to 1.30; sulphur, under 0.10; phosphorus, 0.40 to 0.50; manganese, 0.60 to 0.70; nickel, 0.50 per cent, under the same conditions with the nickel addition the average amount of time was 5½ hours for each gear, so that the use of nickel has become an investment, giving increased production. These castings in the rough weigh 192 pounds, requiring 250 pounds of metal to pour. One and one-quarter pounds of nickel shot were used at a cost of 45 cents per gear. The saving in the machine shop is 3½ hours machine shop time at $1.50 per hour or $5.25; the net saving is $4.80 average on each gear.

Castings were made of the following composition: Silicon, 1.20 to 1.30; sulphur, under 0.10; phosphorus, 0.20 to 0.30; manganese, 0.80 to 0.90 per cent in plain iron which, when the composition was changed to the following: Silicon, 0.90 to 1.00; sulphur, under 0.10; phosphorus, 0.20 to 0.30; manganese, 0.80 to 0.90; nickel, 0.75 per cent, the reduction in machine shop time amounted to 30 per cent with this composition.

Describes Device

IN THIS, the second and concluding section of the article by Mr. Houston, the economic phases of nickel additions are discussed. Several examples of results obtained in operating foundries are given. A simple device which is attached over the cupola spout to facilitate the addition of nickel to the ladle and to make the additions more uniform is described.

Air compressor cylinders were being made by a firm with the following composition: Total carbon, 3.25; silicon, 2.10; sulphur, 0.082; phosphorus, 0.196; manganese, 0.62 per cent. The castings were more or less porous and rejections on account of porosity at times would run as high as 50 per cent and required 25 minutes to mill the base surface and sometimes necessitated changing of cutters three times before the facing operation was completed.

The following composition was adopted: Total carbon, 3.02; silicon, 1.90; sulphur, 0.085; phosphorus, 0.183; manganese, 0.62; nickel, 0.75 per cent. Losses due to porosity were reduced to a great extent and the machine time on milling the face reduced to 8 minutes. The cutting tool was still in good shape for the next casting. In this case there is not only a saving to the foundrymen, but also a saving to the machine shop.

Application of nickel has an advantage both to the machine shop and to the foundryman because the foundry is obliged to replace all castings that do not stand a pressure test. The following is a mixture used in making ammonia compressor heads: Total carbon, 3.14; silicon, 1.35; sulphur, 0.085; phosphorus, 0.30; manganese, 0.85 per cent. This mixture was made up of: Steel, 20 per cent; foundry scrap, 35 per cent; foundry No. 2, 30 per cent; malleable bessemer, 15 per cent. Rejections on these castings averaged about 7½ per cent. The following mixture was substituted: Total carbon, 3.08; silicon, 1.04; sulphur, 0.123; phosphorus, 0.19; manganese, 0.62; nickel, 0.72 per cent. The charges were made up

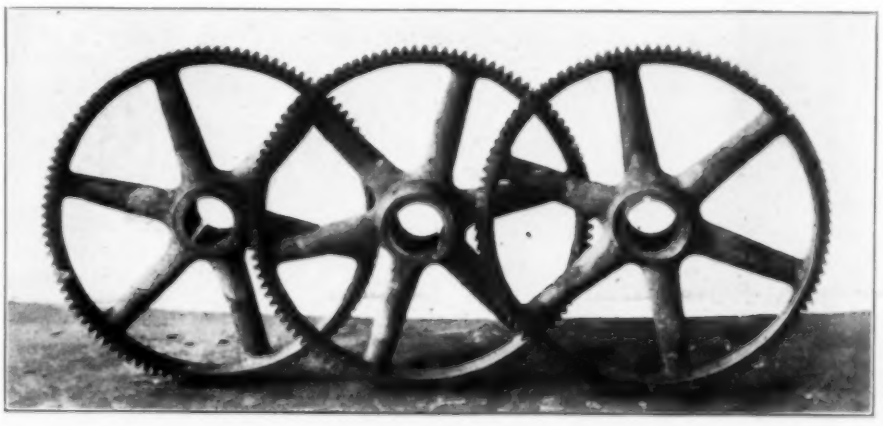


Fig. 6—Saving in time for machining these gears was over 50 per cent after nickel was added to replace some of the silicon. Scrap losses also were reduced

of: Steel, 25 per cent; foundry scrap, 50 per cent; malleable bessemer, 25 per cent.

This mixture resulted in a product in which the foundry losses were lowered greatly. The additional cost for nickel was $5.04 per ton. The selling price of these castings is $135. per ton. The saving to the foundry expressed in terms of scrapped *leakers* per ton was $10.12 or a net saving of $5.08 per ton.

Iron Is Varied

Fig. 7 is a press spindle requiring a close grained iron, the composition of which formerly was: Total carbon, 3.30; silicon, 1.26; sulphur, 0.076; phosphorus, 0.19; manganese, 0.64 per cent. The material cost per ton was $22.85. These castings were fairly satisfactory most of the time and the composition was watched carefully. However, without any change in the analysis or in foundry practice, some of these castings would show open grained iron and rejections resulting from this cause amounted to about 6 per cent. The following mixture was adopted: Total carbon, 3.21; silicon, 0.98; sulphur, 0.121; phosphorus, 0.21; manganese, 0.60; nickel, 1.00 per cent. This mixture cost $26.57 per ton. The castings machined easier and more uniform, and showed a better grain refinement than the former mixture without having any tendency to open grained structure in any of the castings made over a number of months. The selling price of these castings is $110 per ton; 6 per cent scrap loss amounts to $6.60, showing a net gain to the foundry of $2.88 per ton of castings. Table III gives data on plain iron mixture compared with a nickel iron mixture for the same casting.

The foundryman who has not been confronted with the problem of cracked castings is indeed fortunate. Expedients, such as methods of gating, shaking the casting out at the proper time after pouring, digging out cores and such like, are things that most foundrymen would be willing to pass on to the other fellow. It has become standard practice for many foundrymen who are familiar with the use of nickel to use it in problems of this kind. Castings invariably crack when natural stresses and strains on the cooling metal arise. Those arising from an unequal distribution of combined carbon are the ones that cause the foundrymen grief.

Need Even Distribution

A good ,even distribution of combined carbon in the castings will relieve most of the internal or tension strains sufficiently to avoid cracking. In addition to the distributing of combined carbon, nickel additions from 0.50 to 2 per cent toughen the matrix of the metal. Therefore it not only distributes the combined carbon more evenly, but produces a stronger casting. Much trouble that has come to the author's attention has been overcome by the use of nickel in the percentages mentioned. Increased percentage of good castings more than pays for the investment in the alloy content.

One company makes a cover for a controller box in which various mixtures of iron ranging from 1.80 to 3.00 per cent silicon, including a mild semisteel, were used, but could not overcome the cracking of these castings; 2 per cent of nickel shot added to these mixtures overcame the trouble.

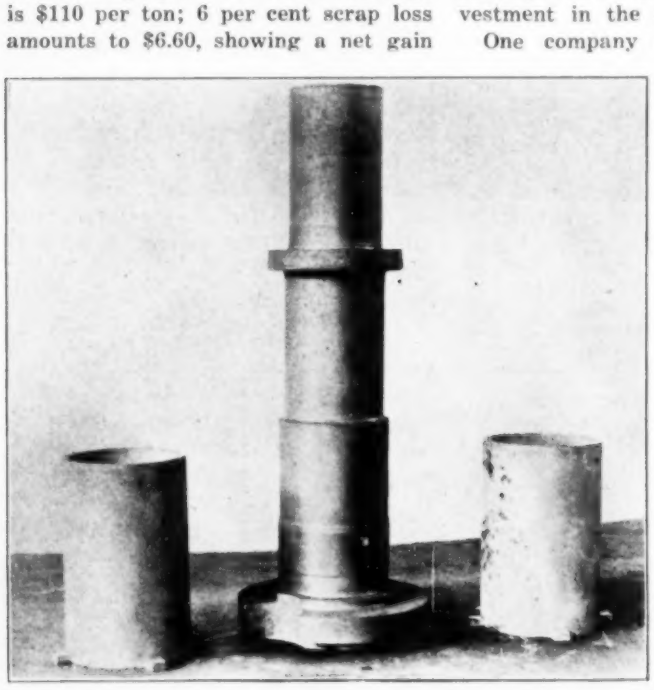
It is regular practice at many foundries to add 1 to 2 per cent of nickel in castings that have a tendency to crack.

Produces Uniform Hardness

Formulating a mixture that will give a satisfactory grain refinement in a heavy section and a satisfactory machinability in a light section is an achievement that any foundryman justly may feel proud of. He is face to face with the two extremes in cast iron metallurgy. When he lowers the silicon and the total carbon to produce a satisfactory structure in the heavy section, invariably the light sections become correspondingly harder through the carbide formations which develop from difference in the rates of cooling. Due to its unusual characteristics nickel may be used to meet this condition according to the following formula: 2 of nickel equals 1 of silicon.

For example, if the following composition is required to produce a satisfactory structure in the heavy section: Total carbon, 3.25; silicon, 1.40; sulphur, 0.10; phosphorus, 0.20; manganese, 0.65 per cent, the light section the composition should be: Total carbon, 3.25; silicon, 2.00; sulphur, 0.10; phosphorus, 0.20; manganese, 0.65 per cent.

The difference in silicon is that be-



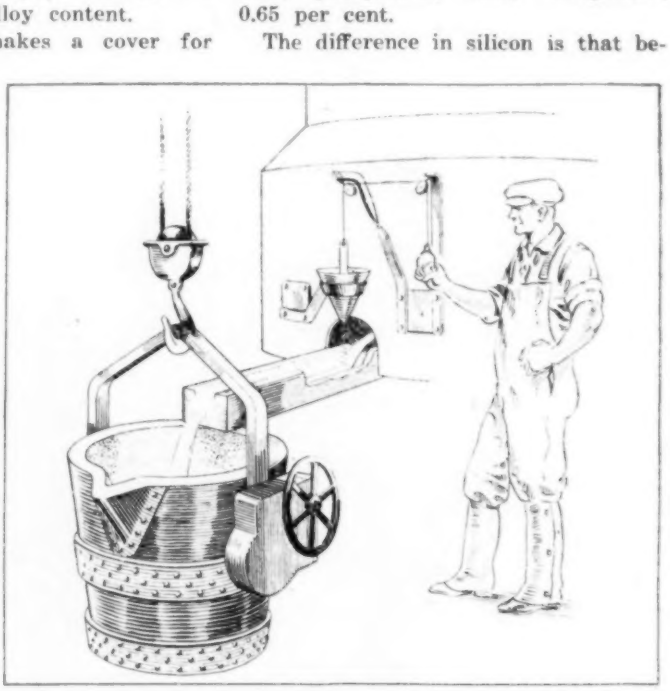


FIG. 7—NICKEL ADDITIONS TO THIS PRESS SPINDLE CASTING REDUCED TENDENCY TO OPEN GRAINED STRUCTURE AND MADE MACHINING EASIER AND MORE UNIFORM. FIG. 8—APPARATUS FOR ADDING DEFINITE AMOUNTS OF NICKEL TO THE LADLE. THE DEVICE IS MOUNTED 10 OR 12 INCHES ABOVE THE SPOUT AND THE IMPACT FROM DROPPING CAUSES THE NICKEL TO DROP BELOW THE SURFACE OF THE HOT MOLTEN METAL

Table III

Comparison of Plain Cast Iron and Nickel Cast Iron

PLAIN CAST IRON ANALYSIS

Material	Pounds	Si	S	P	Mn	Ni	TC
Steel scrap	300	0.20	0.040	0.04	0.45	.....	.....
Special pig iron	100	2.30	0.021	0.22	0.80	.....	.....
Malleable bessemer pig	250	2.50	0.032	0.17	0.80	.....	.....
Cast scrap	350	1.25	0.090	0.17	0.60	.....	.....
Total weight of charge	1000	1.35	0.043	0.14	0.62	.....	.....
Cupola loss or gain	.....	—0.15	0.030	0.00	0.05	.....	.....
Estimated final analysis	.....	1.20	0.073	0.14	0.57	.....	.....
Actual final analysis	.....	1.27	0.083	0.16	0.49	0.00	3.27

Physical Properties: Transverse, 3299 pounds per square inch; tensile, 27,120 pounds per square inch.

NICKEL CAST IRON ANALYSIS

Steel scrap	300	0.20	0.04	0.04	0.45	.....	.....
Malleable bessemer pig	200	1.92	0.035	0.17	0.80	.....	.....
Cast scrap	500	1.25	0.090	0.15	0.60	.....	.....
Total weight of charge	1000	1.07	0.064	0.12	0.60	.....	.....
Cupola loss or gain	.....	—0.10	0.030	0.00	—0.05	.....	.....
Estimated analysis	.....	0.97	0.094	0.12	0.55	.....	.....
Nickel shot to ladle	5	.....	.....	.....	.....	0.50	.....
Estimated final analysis	.....	0.97	0.094	0.12	0.55	0.50	.....
Actual final analysis	.....	0.94	0.112	0.14	0.47	0.51	3.24

Physical Properties: Transverse, 3290 pounds per square inch; deflection, 0.132 inches; tensile, 32,220 pounds per square inch.

tween 2.00 per cent, required in the light section, and 1.40 per cent, required in the heavy section, making a silicon difference of 0.60 per cent. Expressed in terms of nickel, according to the formula given, it means that if the 3.25 per cent total carbon and 1.40 per cent silicon mixture were used, 1.20 per cent of nickel should be added to the mixture. This will give a readily machinable product in the light section and a satisfactory grain refinement in the heavy section.

Change Formula

It must be understood in this connection that this formula applies when the total carbon is not changed materially. For example, 1.40 per cent silicon and 3.00 per cent total carbon plus 1.20 per cent of nickel would not be equivalent to 3.25 per cent total carbon with the other elements remaining the same. However, should it be of economic advantage, the same results may be accomplished by lowering the total carbon, which can be done by the proper use of steel scrap. Twenty-five per cent silicon iron may be used and 3 per cent total carbon which also will produce a satisfactory grain refinement in the heavy section, but may be open to the objection of being hard in the light section.

In this case the formula will be 6 of nickel equals 1 of *carbon*. With 2 per cent silicon and total carbon of 3 per cent instead of 3.25 per cent, the difference in carbon content is 0.25 per cent. This difference multiplied by 6, will give the nickel equivalent. Any combination of silicon, carbon and nickel may be worked out from these formulas to meet individual conditions.

Because of the variations in composition of a metal melted in the cupola, it is highly desirable when employing an alloy like nickel to be able to use just enough and no more. It is obvious on account of cupola variations that if nickel is melted in a cupola, there will be times when the metal will contain more nickel than needed and other times less than is needed. Ladle additions admit of mathematical exactness in the final content of the metal added and results in a product of a given alloy content.

In making ladle additions, it is necessary that it be done in such a way that full recovery of the alloy will be effected. They must be introduced so that they will not interfere with the mechanical features of melting or pouring or chill the metal into which they are introduced. The arrangement as shown in Fig. 8 has many advantages over other methods. An even flow of the alloy dropping into the stream as the metal comes from the cupola at a place where the iron is hottest, and with sufficient impact from dropping 10 inches or 12 inches to be absorbed by the running metal.

Use One Grade of Iron

One prominent foundry has adopted the plan of carrying one grade of pig iron only; that being No. 2 malleable bessemer. This pig iron is melted with gates and sprues or purchased scrap to obtain the higher silicon and higher total carbon metal used for light work. As the sections of the castings increase, the same pig iron is used in connection with the proper percentage of steel scrap, producing a metal lower in both silicon and carbon. Ladle additions of ferrosilicon, nickel and chromium are used when occasion demands. Interest on the difference in the amount of money that would be required to keep many brands of iron on hand and that in the method now employed, is sufficient to pay for a large percentage of the alloys used in that plant.

Pittsburgh Foundrymen Elect New Officers

Members of the Pittsburgh Foundrymen's association elected the following officers for the ensuing year at their regular monthly meeting and dinner held May 16: C. D. Carey, American Steel Foundries, Verona, Pa., president, and W. P. Bradley, American Bridge Co., Ambridge, Pa., vice president. William J. Brant, Pittsburgh, was re-elected secretary and treasurer.

The new executive committee is composed of L. V. Stevens, Locomotive Stoker Co.; W. K. Frank, Damascus Bronze Co.; L. W. Mesta, Mesta Machine Co.; H. T. Herr Jr., J. W. McCormick Co., and R. N. Cook, Eclipse Pattern Co., all of Pittsburgh. The necessity for better merchandising methods in the sale of gray iron castings was pointed out by D. M. Avey, editor, THE FOUNDRY, Cleveland.

Speaks at Chicago

At the meeting of the Chicago Foundrymen's club held on May 14 at the City club, Chicago, D. M. Houston, foundry engineer, research and development department, International Nickel Co., New York, presented an illustrated talk on "Some of the Economic Uses of Alloys in Cast Iron."

Universal Pipe & Radiator Co. and its subsidiaries will remove their general offices to the Graybar building, New York. The subsidiaries include the Central Foundry Co., Central Radiator Co., Molby Boiler Co., Essex Foundry and the Central Iron & Coal Co.

Utley Proposes Fairer Prices

Association President Addresses Philadelphia Foundrymen—A. F. A. Selects Philadelphia Commercial Museum for 1928 Convention and Exhibition

PHILADELPHIA has been selected as the scene of the 1928 convention and exhibition of the American Foundrymen's association, according to an announcement made by C. E. Hoyt, executive secretary of that organization, at a meeting of the Philadelphia Foundrymen's association held Wednesday evening, May 11. The gathering in 1928 will mark the fourth convention of the American Foundrymen's association held in Philadelphia since the society was organized. Other conventions were held in that city in 1896, 1907 and 1919. Choice of an exhibition building for the demonstration of foundry equipment seems to have narrowed down to the Commercial museum, Philadelphia, and an option has been taken on that building for the period May 12 to 18, 1928. The exhibition will open on Saturday, as has been customary during the past few years.

Walter Wood, president of the Philadelphia Foundrymen's association, announced at the meeting that the board of directors of that association at its next meeting would appoint a committee to co-operate with the convention committee of the American Foundrymen's association on plans. It was pointed out that Philadelphia was the birthplace of the movement which led to the formation of the American Foundrymen's association. A proposed feature of the program for the 1928 convention is the honoring of some 50 men living today who were charter members of the American Foundrymen's association.

S. W. Utley, president of the American Foundrymen's association, addressed the Philadelphia Foundrymen's association on "The Foundry Industry." He traced the course of industry through the ages in relation to civilization and contended that the present civilization will escape the fate of every one that preceded it, only because of enlightened policies in industry. Mr. Utley declared that there is an opportunity particularly for enlightenment among foundrymen as to the best business policy to pursue. There are nearly 5800 foundries in the United States, he said, and millions of dollars invested in them, and yet many of these plants do not make anything like a reasonable profit for their stockholders.

> Low prices do not increase the use of castings. More castings are bought when prices are rising or when they are high than when prices are low or falling.
>
> —STUART WELLS UTLEY

He pointed out first that there is an over-capacity in the foundry industry and that the best that that industry can expect at the present time is to operate at some 60 to 65 per cent of capacity. This means that a foundry should not legitimately hope to get enough business to operate at more than that rate. It also means that there is no excuse for foundry plant expansion or for the installation of additional facilities, excepting such as serve to reduce the cost of production.

Mr. Utley pointed out that it is beyond the ability of any one foundry to establish an individual policy which will render it immune from the competition by other foundries. Each plant must stay in business, he said, even though prices are not remunerative, for the reason that it costs more to keep a plant idle than to operate it at unremunerative prices. He cautioned foundrymen to bear in mind the fact that the price at which they have to sell castings is the price which is set by their competitors and that consequently it devolves upon each foundryman to quote prices which carry a legtimate profit.

Mr. Utley, who is president of the Detroit Steel Castings Co., Detroit, said that at his own plant, metal during 1926 comprised 18.8 per cent of the cost of castings, whereas labor comprised 49.9 per cent and other materials and manufacturing expenses comprised 31.3 per cent. These figures show, he said, that it is a fallacy for foundrymen to let pig iron price fluctuations have any undue affect upon casting prices. He mentioned this as an important point for the reason that when the price on pig iron goes down, a good many buyers try to get castings prices reduced by the same amount per ton. Furthermore, said Mr. Utley, the present custom of selling castings per pound is not altogether justified when it is considered that the cost of metal is only 18.8 per cent of the total cost of the castings. Mr. Utley favored an increasing use of the method of quoting castings on the piece rather than the pound basis.

The importance of refusing to shade prices was illustrated in some concrete instances.

"When a foundryman quotes a price of 7½ cents a pound on castings which cost him 6¾ cents to produce," said he, "the foundryman is interested only in the ¾-cent profit. Should he cut his selling price ½-cent a pound, he automatically loses two-thirds of his profit. If the

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THE PHILADELPHIA COMMERCIAL MUSEUM WILL HOUSE THE 1928 CONVENTION OF THE AMERICAN FOUNDRY MEN'S ASSOCIATION

Improve Quality of Gray Iron By Heat Treating

By O. W. Potter

HEAT treatment is an old art which is making great progress through modern scientific methods. Annealing, tempering, forging, hammering, drawing, and casting of the metals and their alloys has been prominent in ancient civilizations, as is evidenced by the remnants found in many ruins. The smiths of old were members of an important craft and were treated usually with great respect and consideration by the ruling classes. They made the metal utensils, ornaments, decorations, and war implements. The knowledge of the smith was a family secret, handed down from generation to generation. He was compelled to rely on his eye in the judgment of temperatures, making use of his experience and the knowledge conveyed to him by his ancestors. Under such methods progress in the art was slow but a remarkable degree of uniformity was maintained.

Modern methods are different. First, the idea of secrecy has been eliminated largely, therefore, the experience and results of many investigators are available. This has made it possible to have experts in different lines, who study the behavior of metals and alloys from various viewpoints. Thus, the chemist, the physicist, the metallurgist, and the practical man have combined efforts in studying the properties of metals. Consequently with chemical analyses, physical properties, microscopic analyses, and pyrometric control, great progress has been made in the field of metallurgy in recent years. Systematic research to obtain the causes and effects of heat treatment has made it possible to control the properties of metals and alloys and adapt them to commercial use.

Iron carbon series of alloys is by far the most important of the commercial materials. It is also one of the most complicated series, yet much research has been done to determine the effects of heat treatment and impurities. By far the greater amount of investigation has been done on the steel side of the series.

To heat treat scientificially any alloy its constitution diagram must be considered.

The lower critical in the iron carbon diagram of Dr. Howe in *The Metallography of Steel* is the same temperature for the whole series, 730 degrees Cent. It is apparent that it is easier to get specific and uniform conditions on the steel side of the series than on the cast iron side. In steel, the stable phase, namely graphite, and impurities, silicon, manganese, phosphorus and sulphur do not need to be considered in the great majority of cases because of the low content. On the cast iron side, both the graphitic and combined carbon along with appreciable amounts of other impurities materially affect this consititution diagram. Investigators have shown that silicon raises the criticals and manganese lowers them and all the impurities have some effect on the critical temperatures.

It is evident that the complex and composition of the cast irons has been a large factor in hindering investigation of the effects of heat treatment. However, the general belief among foundrymen and casting users that cast iron is a cheap, brittle

(*Continued on Page* 429)

O W. POTTER earned the necessary money to put himself through school by working in a foundry in various capacities, including laborer, crane operator, coremaker, molder and patternmaker. This experience was gained in the foundries of the Charles A. Stickney Co., and the Saging Thrashing Machine Co., St. Paul. He received the degree of mining engineer from the school of mines, University of Minnesota, Minneapolis, in 1914. *From* 1914 *to* 1919 *he held several positions and finally became works manager of the Northwestern Steel & Iron Corp., Minneapolis. From* 1919 *to* 1927 *he was connected with the engineering college of the University of Minnesota, teaching various engineering subjects including foundry practice.*

Mr. Potter now is on a leave of absence from the University of Minnesota and has taken over the management of the Winona Machine & Foundry Co., Winona, Minn., manufacturer of gray iron, brass and aluminum castings. In 1921, *Mr. Potter, with the co-operation of the Twin City Foundrymen's association, Minneapolis-St. Paul, organized an extension class for foundry workers which has been successful and still is in operation. During the period he was connected with the University of Minnesota, he did considerable research and consulting work. He received his master of science degree in metallurgy in* 1925.

This article is the first section of the annual exchange paper presented by the American Foundrymen's association to the Brussels congress of the Association Technique de Fonderie de Belgique, April 10 *and* 11. *The second section of the paper will appear in an early issue.*

Table I

Review of Literature on Heat Treating Iron

L. M. Sherwin, THE FOUNDRY, 1917 discusses effects of seasoning gray cast iron. He recommends four methods of seasoning as follows: Allow castings to remain in one position a considerable time before finishing. Rough machine and heat to 204 degrees Cent. for a definite time. Heat from 66 to 149 degrees Cent. before removing scale. Castings heated, cooled, and reheated several times at 204 degrees Cent.

H. B. Knowlton, American Society Steel Treaters, Octooer, 1923, reports some experiments on case hardening and heat treatment of gray cast iron. His work was done at 815 degrees Cent. and over, and some of the results noted were: A great variety of properties developed. Quenched specimens as tough as case hardened low carbon steel. Great hardness obtained. Some specimens tougher than ordinary malleable. Combined carbon was decomposed forming temper carbon. Much less time required to decompose combined carbon in gray cast iron than in malleable.

Bradley Stoughton, *Iron Age*, Jan. 3, 1924, describes the so-called Schaap process, giving some most interesting data. This is the result of a process developed in Brooklyn, N. Y., by Mr. Schapp.

Gray cast iron was heated to 871 degrees Cent. in a muffle type furnace where the metal treated could be protected from the products of combustion. The results obtained were reported as follows: Good results were obtained by an anneal in 45 minutes although the best results were obtained when held at temperature for 3 hours, then cooled rapidly to black in furnace and finally air cooled. Hardness reduced from 240 to 140 brinell, 45 to 35 scleroscope. Reduction in strength both transverse and tensile never over 10 per cent with an average of 5 per cent. Exceedingly pliable. A combination of pliability, ductility, malleability, and resiliency. Uniform structure with no hard spots. Castings did not grow under repeated heating and cooling. No warpage on ageing. Metal did not form white iron upon reheating and quenching. Low coefficients of friction.

From the description this metal likely is a semisteel of at least 20 per cent steel content..

The following information on the machinability of piston castings so treated was given:

	Unannealed	Annealed
Number tested	100	100
Tools worn out	4	None
Max. gage variation	.015	.007
Warpage after machining	Considerable	None
Cutting speed	130 r.p.m.	340 r.p.m.
Depth of cut	⅛-in.	⅛-in.
Travel	2¾-in. per min.	14½-in. per min.

Fatigue values were reported as follows: Annealed gray iron (⅛ x 2 inches) 278,100 repeated stresses before failure. Annealed malleable iron (½ x 2 inches) 136,900 repeated stresses before failure.

J. W. Shaipley and I. R. McHaffie report in *Stahl and Eisen* 1924, experiments on the effect of heating gray cast iron at different temperatures for different periods of time. To break up the combined carbon their results showed the following: Hold for 24 hours at 932 to 1112 degrees Fahr. 500 to 600 degrees Cent. Hold for 6 hours at 1022 to 1202 degrees Fahr. 550 to 650 degrees Cent. Hold for 3 hours at 1067 to 1202 degrees Fahr. 575 to 650 degrees Cent.

Another research on German practice is reported by F. Goerens and N. Gutowski in *Metallurgie*, March, 1908, showing time and temperature required to break up high combined carbon contents as follows:

SOLUBILITY OF GRAPHITE IN IRON

Test No.	Ann. Temp. C.	Ann. Temp. F.	Time hold (hours)	Total Carbon	G. C.	C. C.
1	835°	1535°	5	2.67	.34	2.33
2	835°	1535°	9	2.83	1.41	1.42
3	835°	1535°	19	2.90	1.96	.94
4	835°	1535°	24	2.76	1.93	.83
5	785°	1445°	41	2.76	1.76	1.00
6	785°	1445°	45	2.80	1.87	.93
7	785°	1445°	50	2.72	1.96	.76
8	785°	1445°	55	2.73	2.07	.66
9	785°	1445°	65	2.75	2.07	.68

In 1922 O. Bauer reported on some investigations in Germany. He states that cast gray iron in the pearlitic state is the best for superior physical properties.

J. F. Harper and R. S. MacPherran Allis-Chalmers Co., Milwaukee, have done considerable research on the effect of heat treatment of gray cast iron as reported in *Transactions* of American Foundrymen's association, Vol. 30. Some of the important results noted are as follows: No appreciable effect on hardness for anneals below 1150 degrees Fahr. At 1200 degrees Fahr. both quenched and annealed specimens show considerable softening effect. At 1400 degrees Fahr. and above quenched specimens become very hard.

In 1925 a reported patented process was noted which produced great hardness in gray cast iron by quenching in chemically pure sulphuric acid.

In the early Nineties Outerbridge, *Journal*, Iron & Steel Institute, Vol. 83, No. 1, did some extensive investigation on the growth property and reported the following: Gray iron grew 40 per cent in volume. Test bars 12 inches long grew to 16½ inches in length. Specific gravity reduced from 7.13 to 6.01. Original transverse strength of test was 2150 pounds. Reheated 15 times, transverse strength of test was 1250 pounds. In 15 heatings deflection was reduced from 0.15 to 0.10 inches. There seemed to be no apparent limit to growth. Similar tests were made on white cast iron, steel, wrought iron, tool steel, cast steel, and no growth was apparent.

No recent investigation of this property seems to be available. The cause of growth has been postulated but no explanation has been made which has been accepted generally.

Forsythe did some work in 1924 at the University of Minnesota on dilatation of cast iron. The research was rather limited. No additional new data on this property was obtained but some of the previously reported experiments were confirmed.

A rather interesting account of actual practice has been reported by Fred Grotts, A. S. S. T., June, 1925, on the practice of the Caterpillar Co., Peoria, Ill., in June, 1925. A resume of the results reported is as follows: Anneal at 700 degrees Fahr. of heavy and medium chill mixtures and also gray cast iron shows an increase in transverse strength. Anneal at above 1200 degrees Fahr. shows considerable weakening in strength and an appreciable reduction in hardness.

For castings requiring a chilled surface which must be machined the following procedure is used: Anneal for a short time at 1750 degrees Fahr.; machine; quench from 1550 degrees Fahr.; draw to desired hardness.

This treatment is reported to give no machining difficulties, less wear on tools, the required hardness, and an increase in strength of about 5 per cent.

To avoid quenching cracks, cementite must be broken completely up.

Hard iron subjected to cyanide and oil quench gave better material for valve tappets than heat treated steels (S. A. E., 1020, 2320, 3250, 6150).

Cylinders, cylinder heads, and pistons are given a double treatment. Quench in water at 1550 degrees Fahr. and drawn to required hardness of 35-45 scleroscope.

An anneal at 600 degrees Fahr. is sufficient to remove either casting or quenching strains.

Massive cementite spoils the best tools.

Massive cementite is broken up readily between temperatures of 1750 and 1800 degrees Fahr.

Low silicon content obtained by the addition of steel gives greater strength properties.

White iron heated to 1800 degrees Fahr., quenched and drawn at 1300 degrees Fahr., gives a product which is strong and readily machinable, although of low ductility.

J. W. Bolton, of the Lunkenheimer Co., Cincinnati, in THE FOUNDRY, 1926, gives interesting data on the phosphide, steadite, and the effect of heat treatment on it.

Some of the results are:

Cast iron must be annealed above 1800 degrees Fahr. to absorb fully steadite crystals. Hardness of steadite is over 400 brinell. The amount of steadite formed increases with the amount of combined carbon present.

Albert Sauveur in his text book on *Metallography and Heat Treatment of Iron and Steel* gives definite technical data on cast iron. A complete discussion is given of the iron carbon constitution diagram and the effects of the common impurities, silicon, manganese, phosphorus and sulphur. It is stated that the matrix of ordinary cast iron behaves almost identically with that of the steels of carbon content equal to the combined carbon content of the cast iron. The presence of graphite is the main distinction between the two, cast iron and steel. While he gives no effects of heat treatment, this data is fundamental in the consideration of heat treatment. Although this work contains no specific data on heat treament of gray cast iron, the fundamental considerations relative to the properties of gray cast iron are given fully and clearly.

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material that does not lend itself to economical heat treatment probably has been a greater factor in hindering this development. Heat treatment of the gray cast irons on a regular and commercial basis is a development of recent practice. Stress of production has made it necessary to obviate and eliminate some of the difficulties encountered in ordinary gray iron castings. The late Dr. Howe, an eminent authority on steels and cast irons, stated some years ago that he believed the possibilities of the improvement of the properties of cast irons through heat treatment were even greater than they were for the steels. Cast iron is one of our most important commercial alloys, and although steel, malleable, and stampings are encroaching on its field, it will never be eliminated as an important commercial material.

Cast iron has some exceptionally desirable properties not found in ordinary steels. It casts more readily, has much higher compressive strength, machines quite as readily, has better wearing properties for certain kinds of moving parts, is more noncorrosive, and is cheaper to produce. The difficulties of the ordinary cast iron might be listed as follows: Nonuniformity of properties in general, hard spots, casting strains and warpage, casting growth.

It has been found that heat treatment aids greatly in the elimination of these difficulties. For some years back it has been the practice of some manufacturers, especially machine tool builders, to age castings. Many of them today find that annealing will produce the same result, thus eliminating the necessity for carrying large stocks of castings. It also has been standard practice for some time to anneal car wheels. Heat treating has been found to increase machining speed greatly and also to reduce the tool spoilage.

Growth of Castings

Casting growth is a peculiar property of cast gray iron and always has bothered the manufacturer of machinery subjected to high temperatures or intermittent heating and cooling. This property has been known for some time, Outerbridge doing considerable investigating in the early Nineties. The Schaap process states that this difficulty may be overcome by heat treatment, while others have annealed the castings first, then machined and finally quenched them drastically to produce a white iron which does not grow appreciably.

A short resume of the literature on this subject is given in Table I that the heat treatment of gray cast iron may be considered from a broad viewpoint.

Undertakes Special Research

The primary objects of heat treatment may be stated as follows:

To remove casting strains.

To obtain the desired uniform hardness and the elimination of hard spots which will facilitate machining.

To prevent or control casting growth.

To allow greater accuracy of machining and the elimination of warpage or distortion, after machining.

To provide for the necessary machining and subsequent heat treatment for castings required to be extra hard.

To control the variation of properties of the metal.

After reviewing the literature, realizing the difficulties of the casting user, and recognizing the possibilities of improved properties through heat treatment, a special research was made. The object of the research was to obtain definite data concerning properties involved together with chemical analyses and a miroscopic study. The main idea was the checking of results already reported and assisting as far as possible in determining a proper commercial treatment for specific purposes. It is hoped also that the information will be ample and convincing and will cause a more general use of the process of heat treatment for gray cast iron.

The results of the first series of tests were presented before the American Foundrymen's association at Syracuse, N. Y., at the 1925 convention and are contained in the *Transactions* of that organization for 1925.

A miscellaneous set of specimens was subjected to ten different heat treatments. The final conclusions of this research are as follows:

Proper heat treatment can improve greatly the general properties of gray cast iron and semisteel. One of the important results is a uniform hardness and the elimination of massive cementite under annealing.

To properly heat treat, the correct critical temperature must be located and the temperature carried only enough above this to insure all parts being heated above the critical. This may be determined by ordinary thermal analysis.

The critical temperature of gray cast iron and semisteel may be calculated with a fair degree of accuracy from the chemical analysis according to the following formula: Critical temperature=730 degrees Cent.+(28 degrees X per cent silicon) —(25 degrees X per cent manganese).

Carbon is oxidized when subjected to a quench from just below critical temperature.

The best combination of properties was obtained by heat treatment T-1 (heated to 870 degrees Cent., held for 3 hours, cooled to black in furnace and then air cooled). This was the heat treatment recommended by the Schaap process. This produced a uniformly soft product with only a slight reduction in strength properties.

Holding at high temperature for long periods of time or cooling slowly produces extreme softness, but also greatly reduces the strength properties.

To overcome the difficulty of dimensional changes, gray cast iron may be machined, and then subjected to a quench to produce hard iron which is not affected by intermittent heating and cooling below the critical.

The properties of both gray cast iron and semisteel may be varied greatly by heat treatment and the possibilities of improving and controlling these properties offer great prospects. To do this additional systematic research is necessary for the co-ordination of chemical composition, physical properties, and correct heat treatment along with a study of the microstructures. This along with the use of the ferroalloys in cast iron and semisteel will help to extend their field of usefulness and prevent somewhat the further encroachment of the other metals and alloys.

Use Various Temperatures

A second set of specimens was obtained and the following experiments were made:

Six different sets of test bars, produced under ordinary production-conditions, were obtained from five different plants. The arbitration test bar 1¼ inch diameter by 15 inches long, cast on end according to the recommended practice of the American Foundrymen's association, was used. Thirty test bars of each metal were cast from the same ladle to insure as near as possible the same material for the tests. These were then divided in groups of three and nine sets, or 27 bars, were given nine different heat treatments as follows:

No. 1 Annealed at 500 degrees Fahr. or 260 degrees Cent.

No. 2. Annealed at 1000 degrees Fahr. (538 degrees Cent.).

No. 3. Annealed at 1350 degrees

Fahr. (734 degrees Cent.).

No. 4. Heated to 1600 degrees Fahr. (871 degrees Cent.) and cooled slowly in furnace 24 hours.

No. 5. Heated to 1600 degrees Fahr. (871 degrees Cent.), held for 2 hours and air cooled.

No. 6. Heated to 1600 degrees Fahr. (871 degrees Cent.), water quenched, and drawn to 600 degrees Fahr. (315 degrees Cent.).

No. 7. Heated to 1600 degrees Fahr. (871 degrees Cent.), water quenched, and drawn at 1000 degrees Fahr. (538 degrees Cent.).

No. 8. Heated to 1600 degrees Fahr. (871 degrees Cent.), water quenched and drawn at 1300 degrees Fahr. (704 degrees Cent.).

No. 9. Heated to 1600 degrees Fahr. (871 degrees Cent.), held for 3 hours, and air cooled. Reheated to 1600 degrees Fahr. (871 degrees Cent.) and water quenched. These were so hard they could not be machined and were reannealed at 1600 degrees Fahr. The reannealed bars were marked 9a.

All heat treating was done in an electric furnace having a recording pyrometer attachment.

Chemical Analysis

The effects of heat treatment on the chemical analysis are as follows:

1. Annealing at any temperature reduces the combined carbon.

2. Combined carbon practically is eliminated at anneals of 1350 degrees Fahr. or above.

3. Slow cooling is necessary for the complete reduction of the combined carbon.

4. There seems to be a slight tendency to reduce total carbon on quenching due to surface oxidation.

5. Combined carbon is increased greatly by quenching from above the critical.

Elements other than carbon were ascertained for several of the heat treatments to determine if any appreciable change occurred in total content but none was found. It was thought that certain reactions might take place between the elements and the circulating gases at high temperatures. Since it is known that cast iron is quite porous, the circulating gases no doubt have some influence on the constituents. There may be oxidation or absorption of gases but we had no means of determining this. Recent investigators have shown that the gases do have an important influence on the properties of alloys.

Make Transverse Tests

Transverse tests were made on rough bars, 1¼ inches in diameter, tested between 12-inch supports and autographic testing machine made by Tinius Olsen Testing Machine Co., Philadelphia.

Original arbitration test bars were made in green sand molds and varied considerable in diameter. To determine the exact amount of variation, the diameter of each bar was measured at the fractured section. These results showed considerable variation and no doubt had some influence on the final results. It is the author's recommendation that test bars should be made with greater care, that they should be made in a dry sand mold preferably and that the patterns be made without draft and stripped from the mold. This would no doubt give more uniform results and the tests would be more accurate and useful for comparisons. Broken pieces resulting from the test on arbitration bars were machined to 0.505-inch diameter and tested on 6-inch centers to check the tendencies shown in the rough bars. Both tests seem to indicate about the same things.

The following conclusions were determined from the transverse tests:

1. Annealing below the critical increased the transverse strength slightly. The maximum increases in strength were observed at degrees Fahr. The maximum variation occurred in the *A* and *U* series. This was due to two reasons.

a. The test bars were irregular in shape, having swells and strains.

b. The metal of these two series seemed somewhat oxidized as was evidenced by frequent blow holes. Oxidized metal is known to increase shrinkage difficulties and as a result increases the internal strains due to casting. When these strains are released, the greater the internal strain the greater the recovery in strength.

The test showed that there is a marked decrease in strength when the material is annealed at 1350 degrees Fahr.

2. Annealing above the critical followed by slow cooling greatly reduced strength, the only exception being the high silicon iron (*P* series) which showed a decided increase in strength for the rough bars. On the other hand, annealing above the critical with rapid air cooling gave only a slight reduction in strength properties on the large bars, with the exception of the *U* series which no doubt is due to the presence of the elements chromium, vanadium and nickel in the specimens. The treatment is recommended by the Schaap process where softness is required with a minimum reduction of strength and this investigation substantiates this recommendation. Here again it is interesting to note that the high silicon irons show an increase in strength over the orginal strength rather than a reduction. The variation in the results of the tests on the rough and machined bars on low anneals may be due to the ageing of the small bars before tests were made.

3. Results of the double treatments (quench and draw) seem to be rather erratic. A general tendency is noted toward a decided increase in strength for quench and draw at 600 degrees Fahr. while a reduction in strength occurs as the temperature of the draw is raised.

Reduction in strength appeared to be a maximum when drawn at a temperature just below the critical. These results were similar to those obtained for a straight anneal at about the same temperature.

4. The specimens annealed at 1600 degrees Fahr., air cooled, and then reheated and quenched from 1600 degrees Fahr. were exceedingly hard but weak as shown by the transverse

Table II

Chemical Analysis of Samples Tested

Untreated (As Cast)

	A(SS)	M(SS)	P(CI)	1S(CI)	2S(SS)	U(CI)
Si	1.58	1.84	2.77	1.72	1.26	2.33
Mn.	0.80	0.42	0.71	0.59	0.64	0.56
P.	0.276	0.261	0.527	0.40	0.20	0.295
S.	0.072	0.112	0.070	0.114	0.101	0.096
C. C.	0.80	0.90	0.29	0.75	0.80	0.48
G. C.	2.49	2.37	2.85	2.77	2.68	2.89
T. C.	3.29	3.27	3.14	3.52	3.48	3.37
Ni.						0.00
Cr.						0.62
V.						0.68

Those marked SS are semisteel and those marked CI are ordinary gray cast iron.

tests. This seems to be contrary to the claims made for the Schaap process in which it is stated that after annealing at 1600 degrees Fahr. the material could not be rehardened by subsequent quenching. The author repeatedly produced hard iron after annealing and it is possible that if the complete details of Mr. Schaap's experience were obtainable the apparent difference would be explained. It also is interesting to note that extreme softness was brought about in these same specimens when again annealed at 1600 degrees Fahr. The results agree closely with those of the straight anneal with slow cooling.

The deflections obtained in these tests were considerable, but somewhat less than those of treatment No. 4 (annealed at 1600 degrees Fahr. and cooled slowly).

Results Tensile Tests

The tensile strength varied considerably as would be expected on material of such varying composition. The results showed essentially the same tendencies as the transverse tests. These results might be considered more comparable with other tests than the transverse tests on rough bars since they are machined bars and all the same size.

The anneals below the critical at 500 degrees Fahr. and 1000 degrees Fahr. showed a slight increase in strength. A substantial reduction in strength was shown when annealed just below the critical (1350 degrees Fahr.). The soaking in the furnace from above the critical gave maximum reductions in strength. The U series did not seem to behave in the same manner as the other specimens no doubt due to the alloying elements. The most remarkable phenomenon was obtained with the high silicon irons, the *P* series, which showed an increase in strength for every treatment except one and in particular the long anneal from above and just below the critical which gave great reductions in strength for the other specimens showed an appreciable strengthening in these specimens. This should be of great interest to users of high silicon irons.

The air cooled treatment from above the critical showed an average reduction in strength of 12.3 per cent for all specimens.

The elongation in tension was measured carefully with a stage micrometer and found to be small. It varied slightly and followed generally the deflection in transverse testing. There probably is a slight elasticity but this was not recorded because of difficulty in attaching reporting apparatus. No doubt there is a yield point just before the specimen breaks as there was a noticeable drop of the beam in most cases just before the specimen broke.

The hardness tests followed in general the indications shown by both the transverse and tensile strength; the softer the material, the weaker. The effect of the heat treatment on all of the specimens was substantially the same, with the exception of heat treatment No. 6. This large variation in No. 6 is no doubt due to the difficulty of giving each bar exactly the same treatment. It was rather difficult to control the quenching temperature, the temperature of the quenching water and other conditions of manipulations. The long anneals, No. 4 and No. 9 gave the most uniform results which would be expected since there was no variation in the treatment of the specimens as was the case with other tests.

It is interesting to note the range of variations in hardness extended from 22 to 62 scleroscope or 100 to over 300 brinnell. This indicates that almost any degree of hardness from that of pure iron to that of cementite is obtainable by a proper heat treatment.

The hardness of specimens of the same material under the same treatment corresponded closely, which indicates that uniform results can be obtained by a specific heat treatment.

Call for Refractory Research

SOME impatience was expressed at the annual convention of the American Refractories institute, held at Atlantic City, May 18, over the slow progress that is being made in improving the quality of refractories.

M. C. Booze, formerly refractories fellow at the Mellon institute, Pittsburgh, and now vice president of Chas. Taylor Sons Co., Cincinnati, stated flatly that the refractories industry is not supporting research work to the extent necessary if the industry is to move forward. To a great extent, he said, the industry is manufacturing the same old product it made years ago, and in the same old way. Mr. Booze mentioned a number of points in connection with firebrick which should be the object of immediate scientific investigation. Not enough is known about the effect of pressing; more information about calcining is needed; new methods of molding should be investigated; the effect of the presence of electrolytes should be determined. These are only a few of the subjects which he mentioned as being ripe for investigation if the industry is to meet current needs. Mr. Booze expressed disappointment with the attitude of some consumers who show a disposition to buy firebrick on the basis of price or friendship and refuse to become interested in brick made at a somewhat higher cost, but which possesses much greater than the usual refractory value.

J. M. McKinley, Crescent Refractories Co., and president of the American Refractories institute, stated that progress in advancing the refractories industry is lamentably slow. More information is needed about the characteristics of various refractory materials under all conditions. Standard firebrick specifications are needed. More adequate testing methods are required. He mentioned the effective work recently done in connection with foundry refractories as a result of joint effort by the American Refractories institute, the American Foundrymen's association and the American Ceramics society.

S. M. Phelps, refractories fellow, Mellon institute, described the arrangements by which the Mellon institute conducts research work on behalf of the American Refractories institute. He described an important series of recent tests showing the relation of the moisture content to the pressure and porosity of firebrick.

Work now is being conducted on the control of grain size of flint in clay mix, in view of the effect on the final properties of clay brick. The development of more suitable spalling tests also is under way. He told about the synthetic development of a firebrick which shows almost no linear expansion and which has other admirable qualities, and on which a patent application now is pending.

Leo W. Briggs, Surface Combustion Co., New York, told about troubles which the furnace builder has with refractories. A prime need is a refractory which will serve efficiently in an oxidizing atmosphere. Another need is an insulating material which will withstand 2500 to 2700 degrees Fahr. either in an oxidizing or reducing atmosphere and

which is strong enough so that it may be applied in thin walls; such a material is needed in order that furnace doors may be built without being too bulky or heavy for easy handling. Mr. Briggs emphasized the need for more information about the properties of various refractory materials in different kinds of service that the consumer may buy what will serve him best.

Mullite brick, a product of comparatively recent origin, came up for discussion. M. C. Booze reported on the use of mullite calcined from sillimanite imported from India. He said that brick made with this mullite had shown comparatively small expansion and that such expansion as occurred was uniform and steady under rising temperatures. This brick did not spall readily. It had rendered good service in installations of diversified character. Substantially the only discouraging feature was its unserviceability in contact with slag high in iron oxide. Henry A. Golwynne & Co., New York, confirmed the remarks of Mr. Booze to the effect that mullite brick is not useful at the slag line.

G. S. Evans, metallurgist, the Mathieson Alkali Works, Inc., New York, submitted a paper on the use of sodium compounds in the foundry industry. The purpose of the paper was to create an interest among firebrick manufacturers in the development of a ladle lining material better suited to withstand the corrosive action of sodium alkali slags. The present standard practice is to use a double thickness made from selected, dense, hard, well-burned brick true to form; the lining is laid up dry or with a thin dip made of exceedingly fine material which permits of close joints. It is customary to patch holes with some good plastic firebrick material and, when the brick loosens up materially, to build up a new lining. At present the life of such linings ranges from 24 to 36 heats.

Directors of the American Refractories institute were elected as follows: J. M. McKinley, C. C. Edmonds, J. H. Cavendor, E. M. Weinfurtner, C. S. Reed, E. A. McKelvy, Raymond Sievers, D. A. Benson. It was announced that the institute now has 211 members, of whom 108 are active and 103 associate. Provisions were made at the meeting to carry on the research work at Mellon institute on the same support basis as during the past year. P. S. Kier, Kier Firebrick Co., heads the committee in charge of financing this work carried on at the institute.

Artists Skill Demanded

(*Concluded from Page* 422)

a draftsman will prepare a drawing or several drawings if necessary and submit them for the customer to make a choice.

The selected design then is taken to the pattern shop where in the skillful hands of any one of a number of artisans it is converted into an object of three dimensions, length, breadth and thickness. The medium employed for this purpose may be wood, metal, wax, plaster or a combination of two or more of these materials. A wood, metal or plaster pattern is taken directly to the foundry. A wax pattern first must be reproduced in plaster before it is placed in the sand.

In the foundry the molder takes the completed pattern and makes a mold from it. His part in the program is finished when the mold is assembled for the reception of the metal. However, during the period he is playing his part he has to do many things with his own hands which in ordinary foundries are divided among many men. He has to assemble the flask parts and adjust the bars or bolts to suit the contour of the figure. He must construct and fit into place, all the arbors and hooks required for the cores, undercuts, drawbacks and any other parts requiring support. He makes his own cores by the simple expedient of ramming sand inside the mold and then shaving a sufficient amount of sand from the surface of the inner body to leave a space for the metal. On account of the extremely individual character of most of the castings, molders are not doubled up or shifted from one job to another while in course of construction. Usually when a man begins a job he follows it through alone to completion.

Making up the mixtures and melting the metal is in charge of a man who specializes in that branch of the industry. He is not confronted with problems of porosity, easy machining, tensile strength, or ability to resist pressure which constantly keep the melter of machinable nonferrous castings up on his toes. He has his own peculiar conditions to meet not the least difficult of which is to predetermine the exact shade of color on the castings. Orders are not infrequent in which the only really important factor is that the color of the new casting shall match absolutely the color of one in existence and made probably 20 or 30 years before.

Occasionally the sculptor visits the foundry personally to add a touch or two to a figure or a group, but usually all the necessary finishing and assembling is done by regular employes of the Gorham Co., who specialize in this branch as truly as the designer, the patternmaker, the molder, and the melter specialize in theirs.

Foundry School Students Visit Plants

During the first part of the Easter recess, the board of the French High School of Foundry organized a series of visits to various plants in the north of France to give the students a general idea of the relation existing between metallurgical works and the foundries.

The visits included the foundries of Colin & Co., Guise, manufacturers of stoves and sanitary fittings; the malleable foundry of Ch. Milbled, Dargnies, Somme, and two works in the same district specializing in the manufacture of locks and brass fittings. An inspection was made of the Acieries de Paris-Outreau, near Boulogne, one of the largest steel foundries in the district. This was followed by a visit to the Compagnie Francaise des Compteurs, Marquise, manufacturer of water meters. At Lille, the party visited the plant of the Compagnie Internationale des Machines Agricoles, which is the French works of the International Harvester Co. There they had the opportunity of seeing a foundry organized for mass production on American lines. On the same day they visited the iron and steel foundries of the Fives-Lille works manufacturer of railroad rolling stock. A visit was paid to the brass and nonferrous foundries of Etablissements Jules Cocard. At Valenciennes the iron and steel works of Forges et Acieries du Nord et de l'Est were visited, then the party inspected a coal mine belonging to Societe Metallurgique de Senelle-Maubeuge. On the last day the students saw the works of the Societe Francaise de Constructions Mecaniques, Anciens Etablissements Cail, a large engineering firm with modern foundries reconstructed after the war, and the iron and steel works of the Hauts Fourneaux, Forges et Acieries de Denain et Anzin.

The visits were conducted by T. V. Ronceray, director of studies, and M. Debar, one of the professors of the school.

William G. Ellis has been appointed district sales manager in charge of motor and magnet sales at Philadelphia for the Ohio Electric & Controller Co., Cleveland. His office will be in the Atlantic building, Philadelphia.

Alloys Iron Electrically

Pennsylvania Foundry Makes Ingot Molds from Cupola Iron and Wear Resisting Castings from Electric Furnace Metal

By Frank G. Steinebach

COMMERCIAL activity in Western Pennsylvania long has been divided into manufacturing, mining and farming. Pittsburgh, which in the early days of the nation became the gateway from Pennsylvania to the fertile farming lands of the Mississippi valley, grew into the city of first rank in the manufacture of iron and steel, and today continues to maintain that high position. The territory between the Allegheny and the Monongahela rivers is filled with industrial concerns, large and small, some of which are the leaders in their fields and enjoy a national and international reputation.

Anthracite and bituminous coal are the greatest mineral resources of the Keystone state. The largest bituminous mines of the state are scattered through Allegheny, Fayette, Indiana and Westmoreland counties and the smoking ovens of the coke industry may be found throughout that section. Except in the mountains, the soil of the state is fertile and is used extensively for agriculture and grazing. The agricultural activities of the state consist chiefly in raising grain, in dairying and live stock breeding.

Latrobe, a thriving little city, is located about 40 miles east of Pittsburgh on the Pennsylvania railroad. This old Pennsylvania town is situated in Westmoreland county and appears to be the meeting point of the three great commercial enterprises of the western part of the state. The city lies practically at the eastern end of the great industrial section which centers in Pittsburgh and extends along the rivers both to the east and the west. The city is surrounded by bituminous coal fields and also is the opening of the rich farming land which extends through the Ligonier valley.

Numerous large manufacturing concerns are found within the city including steel, woolen, paper and flour mills, sand plants and brick works. The Vulcan Mold & Iron Co. one of the major industries, is located in the outskirts of the city. A complete description of the plant was published in the Feb. 15, 1924 issue of THE FOUNDRY on page 125.

A little over a year ago the company decided that further expansion of its plant was necessary. Previous experiments in determining the suitability of certain iron for ingot molds designed chiefly for tool steels, high grade soft steel, copper, brass and nonferrous alloys, had shown the

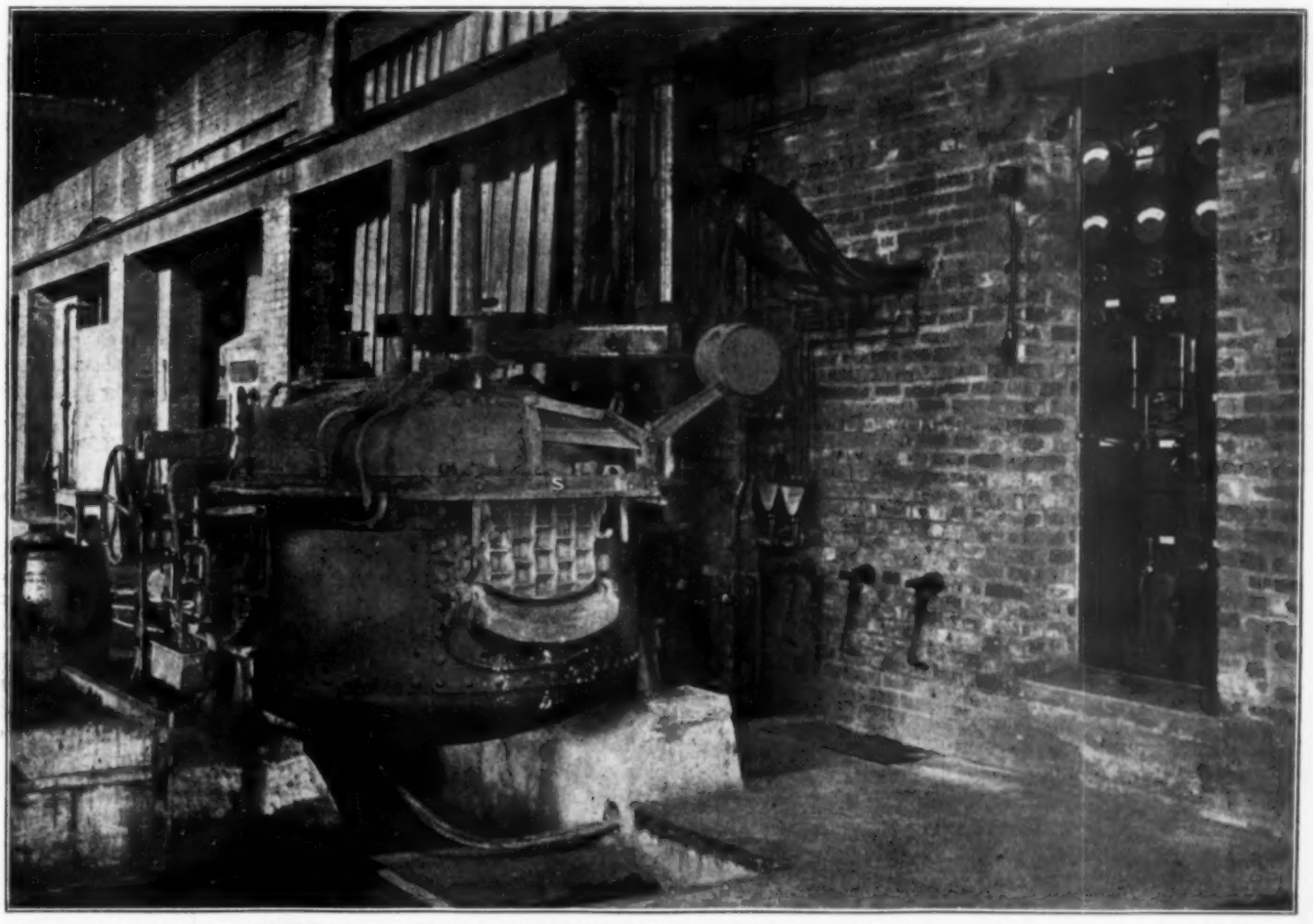

FIG. 1—ALLOY IRON IS MELTED IN A ½-TON ACID LINED ELECTRIC FURNACE WHILE THE METAL FOR INGOT MOLDS IS MELTED IN THE CUPOLA SHOWN IN THE BACKGROUND

value of a special alloy metal which was melted in a crucible in a resistance type electric furnace. The possibilities for this alloy metal in certain classes of work were recognized and further experimental work on more of a commercial scale was planned.

With this feature in mind, the company leased a foundry which is located about a half mile from the main plant. While this property had not been used for several years, it formerly was known as the Peerless Foundry Co. and was used for the manufacture of pipe fittings. This was designated as plant No. 2. The plant is on a sidetrack from the Ligonier Valley railroad which terminates at the Pennsylvania railroad in Latrobe.

The main bay of the foundry is approximately 60 x 360 feet and is divided by a transverse partition approximately in the middle. The back portion is used at present for the storage of sand and some excess equipment, but plans call for the later use of this space as a molding floor. A machine shop for finishing the castings is located in front of the bay used as the molding floor and a pattern shop and small testing laboratory are installed above the machine shop. The cleaning room with two tumbling barrels and a large table sandblast installation is placed between the foundry and the machine shop.

The cupola is built in a special room on one side of the bay, with the spout leading into the main bay as may be noted in Fig. 1. A second cupola which is not used at present is situated behind the boarded section as is shown in the illustration. A feature of the new equipment which has been added to the plant is the ½-ton acid-lined electric furnace which was designed to melt cast iron and has automatic control apparatus, as is shown in the illustration.

The coreroom is located at right angles to the main bay and directly opposite the electric furnace and the cupola. This department contains a core blowing machine, core machines and other equipment used in making special cores. Two rack type and one drawer type ovens are provided. The wing housing the core department is constructed with maximum window space along the sides thus giving ample natural illumination.

Raw materials are received on the sidetrack of the Ligonier Valley railroad. The raw materials for charging the cupola and the electric furnace are unloaded immediately adjacent to the melting departments. The charge is carried to the charging floor of the cupola on an elevator. The tracks are depressed to add to the ease in unloading the raw materials from the cars and in loading the manufactured produets into cars for shipment.

Plant No. 2 was established primarily for the development of the electric furnace alloy iron and it was expected that the entire plant would be devoted to jobbing work. However, shortly after the plant was taken over by the Vulcan company, the main plant became crowded with work and it became necessary to devote a portion of the new plant to the production of special one piece ingot molds, split molds, and equipment for the main plant, such as core bars, etc. Approximately one half of the foundry is devoted to this general line of miscellaneous castings.

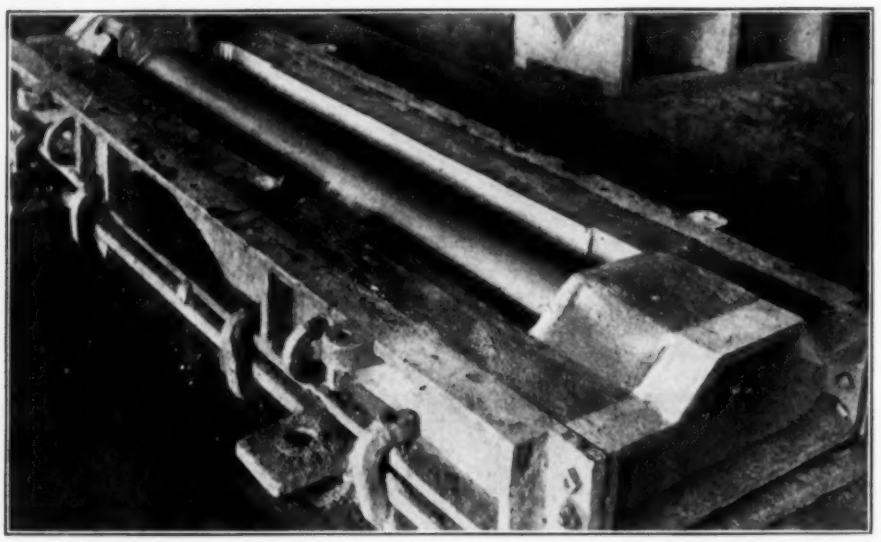

FIG. 2—MUCH OF THE SUCCESS IN MAKING THIS HALF OF AN INGOT MOLD DEPENDS ON THE CARE EXERCISED IN BLACKING AND DRYING THE MOLD

The split ingot mold is cast in two sections in the foundry and the halves are machined in the machine shop so that an exact fit is secured. When ready for use in the steel mill the halves are assembled and are held in place by a loose band and wedge. After the steel ingot is poured, the wedge and the band are removed, the two halves of the mold taken apart and the ingot lifted out.

Two important factors governing the life of the ingot mold are a smooth inner surface where the mold comes into contact with the hot metal and a good quality of metal in the mold. Both of these factors are watched closely. Since many of the molds made by the Vulcan company are used in the manufacture of alloy steel ingots, which require close tolerances, the limits of the mold are watched closely and particular care is given to securing a smooth velvet-like surface on the inside of the ingot mold. An interesting example of an ingot mold which requires exacting work is shown in Fig. 2. This is a split mold used for the production of a brass ingot.

The mold is 71 inches long and the core measures 68 inches. The core is tapered from 7 21/32 inches at one end to 7 19/32 inches at the other extremity. A variation of 1/64-inch is allowed in the diameter of the core. The half mold is molded in two parts with the core made in the drag as is shown in Fig. 2. The core is green sand with an arbor running the entire length of the mold and connecting with holes at both ends of the cast-iron flask to permit the gases to escape. The mold first is rammed, the pattern being placed convex side down on the follow board and the drag set on the board. The drag mold then is rolled over and the pattern is drawn. An experienced molder carefully smoothes the core and applies the blacking. Much of the success in producing a mold with a smooth, perfect inside surface depends on the proper application of the blacking. After the blacking has been applied, the surface of the mold is skin dried with a gas torch. The photograph which is reproduced in Fig. 2 was taken shortly after the drying process had been completed and the mold was ready to be closed.

Two gates are provided at the open end, as shown in the illustration. The metal is poured into a special basin at the top of the cope. The basin discharges into a single runner through the cope and this in turn feeds the two gates which ex-

tend to the bottom of the drag mold. The iron first enters the mold at the lowest point, but the gate is open the length of the drag so that the metal enters the mold at the level of the metal already in the cavity. Eight 1½-inch risers are distributed over the cope, four on each side. These risers are placed over heavy sections in the castings.

The company recently has completed a much larger split mold of the same type which will be used for alloy steel. That mold is 128 inches in length with a 9-inch diameter center and a maximum tolerance of the two halves combined of 1/16-inch.

The work of this department is made either in flasks or in pits, depending largely on the requirements and the number of castings needed. Where exactness is necessary, as in the case of the split mold already described, flasks are used. The core bars, which are made for the main plant, usually are made in the pit.

After the castings are pulled from the sand, they are carried to the front end of the molding bay by a 5-ton crane which serves the main foundry floor. Here they are placed on special skidways and are cleaned and the gates and risers are removed with chipping hammers. The molds then are taken to the machine shop in the extreme front of the building on a monorail, where the necessary machining is done to fit the right and left halves together.

A considerable portion of the remainder of the foundry floor is used for small jobbing work. Some of the castings which have been produced in this department are shown in the accompanying illustration. These include valves for a large engine, conduit boxes, radio horns, etc.

Conduit boxes of the type in Fig. 3 and boxes with two compartments are manufactured. These boxes consist of three parts, namely the receptacle, the adjusting frame and the cover. The box wall measures 3.32 inches across the smallest section. Two patterns for making the boxes, frames or covers are mounted on a matchplate. The molds are made on a squeezer machine, the average molder making 80 frame molds or 55 box molds in a day. The molds are gated with four gates along the side, two gates being near each end. These conduit boxes are used as a part of the electrical wiring system in the construction of fireproof buildings.

Methods recently employed in molding a radio loudspeaker horn, shown in Fig. 3, are interesting. The pattern for the horn was split in the middle and the halves of two horns mounted on the pattern plate. Four pins were used on the plate to insure against any possible shift. The core for two horns was made in one piece on a core blowing machine and was placed in the mold with considerable ease. The core was supported at the two ends of the horn and held securely so that chaplets were not necessary. This method of molding was adopted because the requirements for a smooth surface on the inside and outside of the horn made the use of chaplets impossible. The mold was gated in the center with four runners, two running to the flare and two to the collar at the narrow end of the casting. The casting is 3/64-inch thick through the thinnest section.

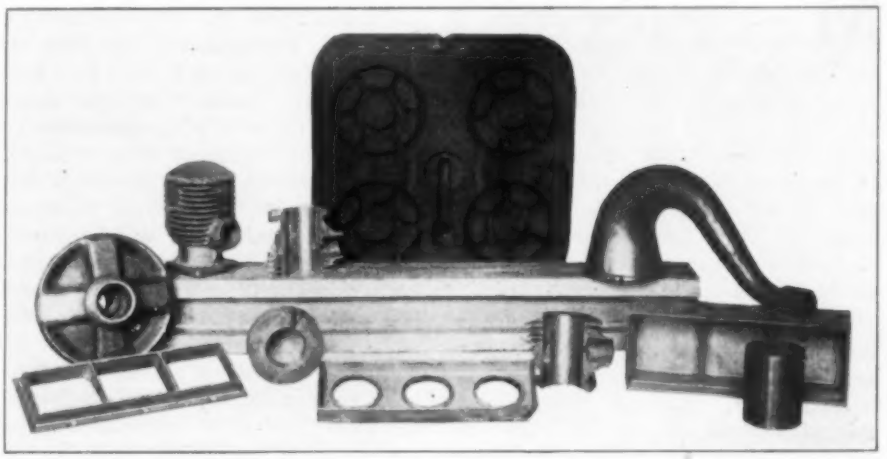

FIG. 3—THE CYLINDERS, PISTON AND VALVE ARE OF ALLOY METAL WHILE THE CONDUIT BOXES, RADIO HORN AND INGOT MOLD ARE OF GRAY IRON

The core shown at the background of Fig. 3 is used in making the valve shown at the extreme left. This casting formerly was made with the part that had to be machined in the cope. Trouble was encountered insecuring sound castings by this method so the molding method was changed and the part to be machined was placed in the drag. Sound castings were secured by this method. The core shown in the accompanying illustration takes the place of the cope.

Although the demands of the main plant have cut heavily into the production capacity of plant No. 2, much work has been done in making various types of castings of the alloy metal melted in the electric furnace which is shown in Fig. 1. Transformers and other control equipment are housed in a special room immediately in the rear of the electric furnace. The furnace is controlled from the panel board shown at the right.

The iron is melted at high temperatures which provides an easy control of the analysis of the alloyed iron. An exceptional high recovery of the alloys is secured and the alloys are dissolved thoroughly in the iron. It has been found in the work undertaken thus far that it is possible to duplicate any analysis readily.

Nickel and chromium are the chief alloys which have been used thus far in making the alloy metal although experimental work is being carried on with tungsten molybdenum, cobalt and manganese. The chromium is added in the form of ferrochrome and the nickel in the form of pure nickel. The percentages of chromium used have ranged from ½ to 15 per cent and the nickel has varied from 1 to 10 per cent. The proportion which has been used for the majority of work is one part chromium to two parts nickel.

Several properties of this alloy iron contrast it with the ordinary grade of cast iron. The tensile strength of the iron is high, averaging about 50,000 pounds per square inch. Tests with this iron have shown that it is several times more resistant to wear that ordinary gray iron. The alloy iron also is resistant to heat, acids, alkalis and other corrosive liquids, scaling at low temperatures and rust. The alloy iron is fine grained and the dense structure permits the iron to take a high polish. Due to the elimination of hard spots, the iron machines readily even at a brinell hardness of 225 to 275.

The list of equipment that has been made of the alloy iron and already tried to prove the value of the properties in service is interesting. Considerable equipment has been manufactured for steel mill plants and include piercing points, rolling mill plugs, expanding mill plugs, guides, pipe balls, pipe bells, rod mill guides, wire drawing dies, hammer dies draw rings and pressing die. The alloy iron has found a market in the glass

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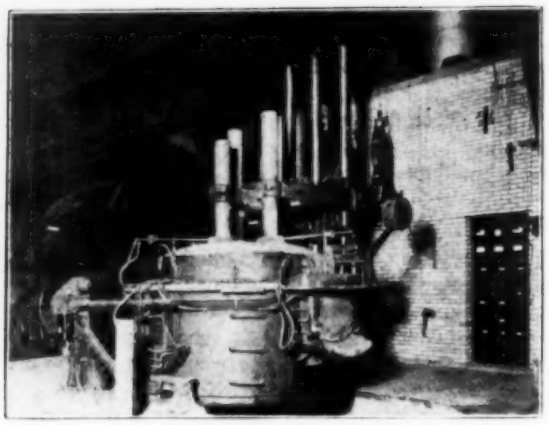


Fig. 1—A Typical Furnace Installation

Arc Furnace Design *Involves* Numerous Features

By W. E. Lewis

MORE than 25 per cent of the steel for castings made in this country now is melted and refined in electric furnaces, and a large number of these furnaces are also at work turning out quality gray and malleable irons. To the foundryman who has little time to give to the study of the theory and design of these furnaces, a discussion of their construction undoubtedly will be of interest.

To develop this subject logically, the natural starting point is at the arcs as they are the means of delivering heat. The arc will be considered essentially as a high resistance, gaseous resistor through which a current, composed of infinitesimally small particles of electricity called electrons, is hurled by a voltage pressure sufficient to maintain the flow between the vertical carbon or graphite conductor known as the electrode and the metal of the charge. The *brake* effect of this zone liberates sufficient heat to gasify some of the electrode and this gas being quite conductive assists the voltage in forcing electrons through the arc gap which resists their passage. Naturally, these contending forces develop heat in proportion to the intensity of the pressure and resistance. The quantity of heat developed in an arc *each second* in gram calories (the amount of heat necessary to raise the temperature of 0.0353-ounce water 1 degree Cent.) generally is expressed as 0.24 x current x voltage, or as 0.24 x current squared x resistance, or as 0.24 x voltage squared divided by resistance. This formula is derived from Joule's law and is used considerably in electrical computations.

Before developing the detail of arc heat by computations, it is advisable to point out that current densities and magnetic repulsions evidently determine proper conductor dimensions, while safety to furnace operators, good refractory life and steady arcs are important voltage determining considerations in furnace design. Three-year operation data of a direct series arc furnace manufactured by the Pittsburgh Electric Furnace Corp., Pittsburgh, on acid steel, cold scrap practice are given in the accompanying table. Computation of the arc resistance heating in the case of one of these 3-ton heats requiring 1725-kilowatt hours or 575-kilowatt hours per ton will be shown.

Since one-kilowatt hour is equivalent to 860,400 gram calories, then the heat equivalent of 1725-kilowatt hours is equal to 1725 x 860,400 or 1,484,190,000 gram calories. At 80 percent thermal efficiency, approximately 1200-kilowatt hours will be required to melt down 3 tons of cold, mild-steel scrap. Therefore, 1200 x 860,400 equals 1,032,480,000 gram calories. Consequently, approximately 2/3 of the heat are required to melt the scrap and 1/3 of the heat is used for purposes of alloying, superheating and refining the bath, and to allow for radiation, thermal losses due to cooling and convection after the melt down, etc.

In a 3-phase circuit, star or Y-connected, the voltage flowing in each phase is equal to the supplied voltage divided by $\sqrt{3}$ and the current in each phase is assumed to be equal to the supplied amperage divided by 3. Assuming 100 volts pressure used during a melt-down period of 80 minutes, the current flow per phase for a 3-phase, direct arc furnace would be computed as follows:

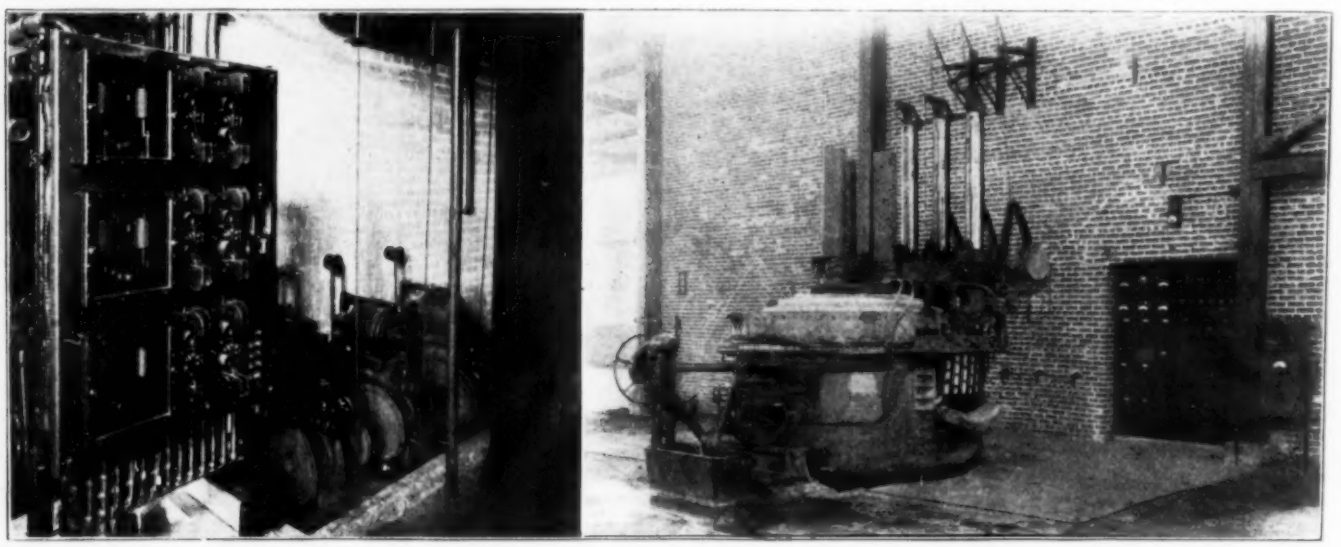


FIG. 2—VIEW OF ARC REGULATING DEVICE AND WINCH MOTORS WHICH ACTUATE THE ELECTRODES INSTALLED IN THE TRANSFORMER ROOM. FIG. 3—SHOWS ANOTHER ARC REGULATING DEVICE OF DIFFERENT MANUFACTURE PLACED IN THE FURNACE ROOM

$$1{,}032{,}480{,}000 = 0.24 \times 100 \times \text{amperes} \times \frac{}{\sqrt{3}}$$

80 x 60 x 3 from which the current per phase equals 5177 amperes. The heat developed between each electrode and the metal bath per second would be:

$$0.24 \times 100 \times 5177 = 71{,}700 \text{ gram calories}$$

$$\frac{}{\sqrt{3}}$$

To supply 1200-kilowatt hours in 80 minutes or 1 1/3 hours, 900-kilowatt hours per hour must be delivered. This requires a 900-kilowatt demand on the high tension supply line.

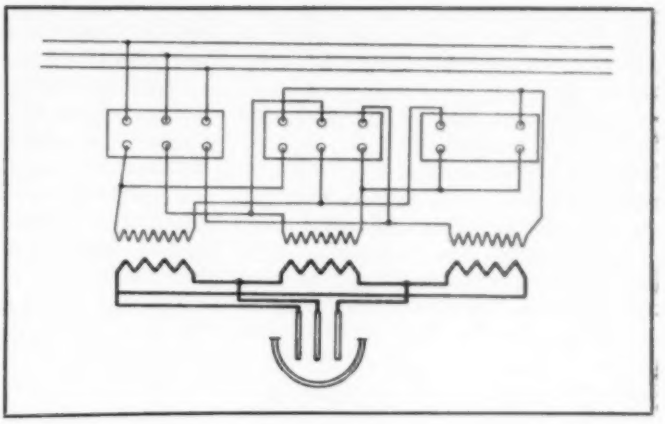


Fig. 4—Diagram of a delta or star-delta secondary connected transformer arrangement

In the design of electric furnaces the best results can be obtained only by properly correlating voltage, wattage, electrode spacing, furnace dimensions, etc.

As will be developed, the currents in the heating circuit are driven by the pressures exerted by the heavier section transformer coils. Considering a phase to the metal bath, we find it composed of an oil insulated copper coil, a copper secondary cable between the transformer and furnace, a copper bus bar and clamp, a carbon or graphite electrode, the arc, the slag, and the metal. They are all good or fairly good conductors with the arc excepted. These conductors evidently are composed of atoms while the arc consists of volatilized carbon and slag vapors so that it has atomic structure. In a limited sense as in gases, the atoms or molecules are separated by relatively enormous distances in comparison with solids. Each atom is composed of a central core about which electrons revolve much as the earth and similar planets revolve about the sun. When voltage pressure is applied to a circuit, electrons are torn from their normal orbits and hurled into adjacent systems. These disturbed systems in turn release some of their electrons and a flow of electrons is begun. Evidently, good conductors are composed of atoms which release their electrons readily and insulators are atoms which strenuously oppose the entry of new electrons into their system.

Having indicated the nature of arc heating, the mechanical construction of the furnace proper will be considered. Furnace shells are fabricated of stout, steel plates, which in turn are lined with acid or basic refractories. Acid or siliceous materials are used where no phosphorus or sulphur is removed. These undesirable elements must be withdrawn from the metal by limey slags which would attack an acid lining.

The temperature to which the refractories can be subjected, without melting, is one of the most important factors in applying heat properly. As long as the charge is not molten, power can be introduced rapidly, as nearly all the heat will employ itself in fluidizing the metal. However, when the bath is formed, it approaches the temperature of the refractories and the latter therefore absorb more heat. For this reason as soon as the charge is melted down, the best practice is to curtail the power delivery to the furnace by lowering the heat input by suitable transformer taps, connections, or other changes.

The roof should be readily removable and for this reason is customarily arched from a sturdy circular expansion, riding-roof ring bear-

Operation Data of Foundry Steel Furnace

Tons per month	K. W. H. per ton	K. W. demand	Minutes per ton	Tons per roof	Tons per sidewall	Pounds carbon electrodes per ton	Tons charged per heat
245	595	952	44	.....	.....	11.5	3.07
356	582	974	42	650	650	10.1	3.01
521	593	945	42	.....	.....	11.5	3.07
533	580	961	42	.....	504	10.0	3.06
363	548	967	42	1250	746	9.58	3.08
360	636	941	42	.....	.....	10.8	3.05
450	542	901	41	491	491	14.0	3.05
534	558	981	41	674	508	10.8	3.08
668	538	944	41	.....	608	9.55	3.07
647	580	1008	42	.....	.....	9.67	3.06
567	562	950	41	1530	979	9.19	3.06
572	553	912	41	.....	.....	9.00	3.06
584	503	1005	39	.....	.....	9.00	3.04
587	588	952	39	.....	860	8.4	3.05
671	506	951	39	2362	1053	9.5	3.10
624	530	940	39	.....	.....	8.3	3.25
624	533	953	39	1182	1182	8.7	3.33
702	506	964	39	.....	.....	8.5	3.23
630	525	967	39	.....	.....	8.5	3.18
498	555	1002	39	1650	1650	8.6	3.31
576	526	958	39	1312	1414	9.0	3.25
661	483	980	39	.....	.....	8.0	3.27
573	613	972	39	.....	.....	8.6	3.22
550	495	999	39	.....	.....	8.9	3.29
601	575	1002	39	.....	1699	11.6	3.16
570	539	986	39	.....	.....	7.9	3.34
800	530	969	39	3172	1575	7.7	3.17
723	507	957	39	.....	.....	8.6	3.09
613	561	972	39	1450	1044-482	9.4	3.03
684	516	1000	39	.....	848	10.2	3.07
588	544	961	39	.....	.....	7.8	3.10
653	518	948	39	1524	677	9.6	3.07
564	521	1004	39	939	869	8.9	3.07
526	572	987	39	.....	.....	11.0	3.11
457	561	1010	39	1130	1060	13.4	2.93
465	520	941.5	39	.....	.....	12.8	2.66
Av. 566	546	964	40	1380	945	9.8	3.11

ing the skew backs. Silica brick are used most commonly. The roof is pierced to pass the three electrodes which are water cooled by means of anti-magnetic cooling glands of proper bore and formation.

As the vertical masts on which the arms carrying the electrode travel, are placed on the transformer room side, the spout may be placed at right angles to the masts or diametrically opposite. Either one or two doors for charging and working are used.

Electrode arms must be aligned accurately to travel with great smoothness and minimum friction on accurately machined mast guides. They are supported and positioned by means of steel cables reeved on winch drums coupled to direct-current motors which operate to raise or lower the electrodes as they are energized by the automatic regulators. The arms should be counterweighted as more accurate regulation is secured with less strain on the motors and automatic regulator magnetic contactors. Fig. 5 illustrates a patented counterweighted controlling mechanism.

The furnace may be either motor or manually tilted on meshing-sector trunnions or it may be inclined on rockers by motor-driven screws or gearing.

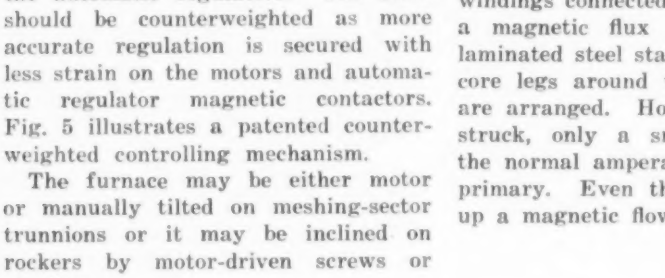
The furnace bottom should be connected preferably with the neutral point of the transformer, load-pressure coils as in this way unbalanced currents can return to neutral. A more steady high side current will be drawn and quicker starting of the heats is obtained with minimized line surges. By purposely unbalancing one of the phases, the neutral may be employed to heat the bottom.

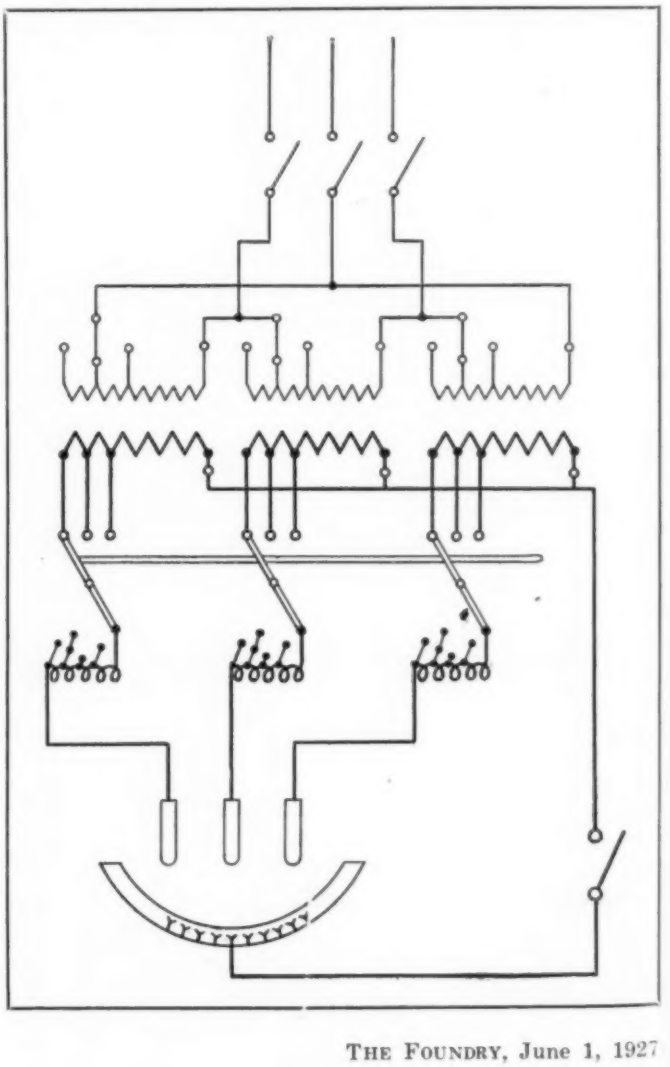
Economical transmission of power from central station generators necessitates sending it out at high voltages which must be lowered by an appropriate ratio, power transformer at the plant. Electric furnace multi-voltage transformers (acid and basic ranges) must be constructed especially rugged to withstand the vibratory stresses of furnace operation. They are cushioned by surge restraining choke coils which limit electron rushes and in addition an automatic breaker trip for overload is provided.

Electric furnace transformers are of the step-down type. They change the power drawn by the charge from the high, supply-line voltages to low voltages with accompanying higher amperages. Being stationary they require little attention and their maintenance is low. Either the polyphase one tank type or the earlier three single phase tank bank may be used.

When high pressure voltage is applied to the high side or primary windings connected to the power lines, a magnetic flux is induced in the laminated steel stampings forming the core legs around which the windings are arranged. However, with no arc struck, only a small percentage of the normal amperage can flow in the primary. Even this current will set up a magnetic flow in the core which in turn will induce a counter-pressure in the primary coils practically equal to the line voltage. On striking arcs the condition is changed. Current flowing in the secondary will weaken the counter-pressure of the primary so that sufficient current can flow into the primary to supply the wattage drawn by the secondary. It is the play of the magnetic flow in the core on the secondary windings which causes them to develop electron-driving pressures practically proportional to the high to low side turn ratio. Stepping down 22,000 volts to 63.5 volts will require 3460 primary turns with a 10 turn secondary. It will be evident that by tapping the coils at various points the low side voltage may be varied. Series or star connections may be used or any one of a number of special arrangements may be employed. For example, assume a delta high side (head of each of three coils connected to the tail of another) passing 900-kilowatt at 22,000 volts. Evidently the voltage across each primary winding will be 22,000 volts. Assuming 90 per cent power factor (the electrons are lagging the voltage so that their full effective power value is not realized)

Fig. 5—Elevation of an electric furnace installation showing arrangement of apparatus. Fig. 6.—Diagrammatic representation of a delta-star secondary connected step-down transformer with taps to vary the voltage





the current drawn from each supply line will be $\frac{900{,}000 \text{ watts or } 1{,}000{,}000}{0.9}$ divided by $1.73 \times 22{,}000$ or 26 amperes. With the secondary star-connected (the tails of the three phases joined) with the shell tied to neutral, the amperage per balanced low side phase would be approximately 5000. With the high side star-connected, the voltage across each primary would be 22,000 divided by $\sqrt{3}$ or 12,700 volts and the low side voltage per phase would be 36.8. Figs. 4 and 6 show connection diagrams published by the leading furnace builders.

We will now consider regulating the power delivery. Assume three ½-inch arcs receiving 1000 amperes at 100 volts and three 1-inch arcs receiving 3000 amperes at 75 volts. The power received by the three ½-inch arcs would be 300 kilowatts and 675 kilowatts with 1-inch arcs. Evidently an alteration in the position of an electrode will affect greatly the power it will pass.

On shortening the arc, more electrons can be forced through the arc gap while elongating the arc decreases the amperage. With this in mind, let us say that we want a constant power delivery of 675 kilowatts which under the conditions above requires the maintenance of three 1-inch arcs. For simplicity, we will assume that the charge is molten and *dead* so that the gasifying of the electrode is the only thing disturbing the arc length. With the electrode unregulated the arc will wander around the end of the electrode until the voltage rises so high that the arc ruptures. Hence the electrodes must be lowered gradually to compensate for volatilization.

Under the condition just mentioned the simplest automatic control would be based on maintaining a constant current of 3000 amperes. By placing series or current transformers on the three secondary cables, secondary circuits would be obtained which would vary as the amperage going through the arc. These circuits would be wired to contactors which operate the winch motors to raise the electrodes when the amperage exceeded 3000 and lower them when the amperage fell below 3000. Multiple rheostats across the control circuits enable any setting desirable to be made. This is the fundamental principle of the operation of the automatic regulator designed by the General Electric Co., Schenectady, N. Y., shown in Fig. 3.

Fig. 2 shows a regulator manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., which embodies additional voltage control circuits which are used to lower the electrodes, the current circuits employed in raising the electrodes also are devised to reduce the current input. Additional anti-hunting, speed adjusting, and load varying controls are provided.

Another of the more prominent substation parts is the oil switch which carries power to the installation when closed, and disconnects the load when opened. Oil circuit breakers must stop or take on the rush of current and consequently must be designed for heavy duty service. The rupturing process especially gives rise to high temperatures and pressures. The function of the oil is to quench the arcs drawn on parting the contacts and to insulate effectively the live parts. Since the design of oil switches and breakers must be based largely on empirical data, considerable experience is necessary to properly specify suitable breakers for furnace loads.

It is especially important that the oil does not become overheated by continuous full load current. More ample and firm contacts must be made as the capacity of breaker increases. Expansion orifices should be arranged so that sooty deposits are not formed on insulators by quenched gaseous hydrocarbons. Oil should not be permitted to be fouled by sludge, dust, or moisture in suspension as they greatly weaken its dielectric strength.

It is impossible in an article of this length to enter completely into the interesting phases of electric furnace construction, but it is hoped that the information contained will help in making the clean heat operations of arc melting and refining more generally known.

Alloys Iron Electrically

(*Concluded from Page* 435)

industry where such articles as glass molds, both one piece and sectional and also glass mold plungers have been made. Pistons for automobile cylinders and air cylinders have been made and tried in service.

Considerable equipment which must be subjected to heat has been made including doors, door frames, bearing blocks, acid pots, annealing pots, molds of various descriptions and annealing pipe.

With the equipment used, the company is in a position to produce an alloy iron of any desired analysis. In adapting alloy iron to any new use, the company first determines the demands that will be placed on the casting and then produces the casting from an analysis that will give the desired properties required under the conditions.

A small experimental type electric furnace of 400 pounds capacity recently has been installed for laboratory work. Sample castings are made of new mixtures and these castings are tried out under actual mill conditions. When the proper mixture is established, the production is transferred to the larger furnace where duplication of the mixture is possible. Customers thus are given the opportunity of trying small quantities of special alloy castings with the knowledge that the mixture may be duplicated in larger quantities of castings later.

Ask for Simplification in Coke Grades

At the request of the Ohio Foundrymen's association and the Gray Iron Founders' association, the simplified practice division, department of commerce has been asked to co-operate in the further simplification and standardization of grades and specifications of by-product coke for foundry purposes.

In this connection R. M. Hudson, chief of the division is sending out a preliminary letter to ascertain the consensus of opinion of the coke producers as to the possibilities, benefits, etc., of simplification of foundry coke grades and specifications. In his letter calling attention to the request of the associations for this co-operative work, Mr. Hudson says in part:

"Those bodies point out to us that there is no real need among foundrymen for so many different grades of coke and specifications therefore as exist, and that a reduction of the present diversity by the elimination of the unnecessary grades, etc., would be of definite advantage to the purchases as well as the producers of by-product coke. The foundrymen are willing to standardize their requirements and desire the co-operation of the producers to that end."

Some of the questions asked of the producers include:

"Is the present diversity in specifications, etc., an advantage or a disadvantage to the coke producers? Will closer standardization simplify your production and marketing problems?"

As soon as answers have been received they will be tabulated before any other steps are taken.

The Oakland Brass Foundry has been removed to 2319 Clement avenue, Alameda, Calif.

Bill Listens to the Interesting Blacksmith

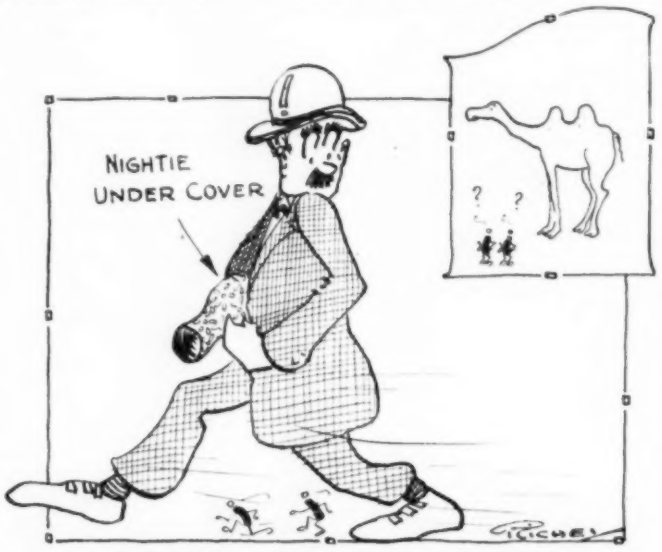
By Pat Dwyer

BILL was down to the old homestead recently and after he returned he came over to the house one night to regale us with some of the incidents, impressions and gossip he had accumulated during the visit. He found himself almost a stranger in a town where at one time he knew every foot of the territory and had at least a speaking acquaintance with every man, woman, child and dog in the place. The old dirt streets had been paved. Old rookeries had been torn down and replaced with more or less pretentious buildings. Old firms had disappeared or had been rearranged in different combinations. Several moving picture houses had blossomed into existence and displayed the attractions to be seen everywhere. Most of the people were strangers and among those he knew, some had forgotten him and others had not the slightest idea where he had settled or where his present home was located. "Let's see" they would say, "You're living somewhere out west, ain't you?" "In these modern days," said Bill, "with means of communication so easy it seems funny to find people with such vague ideas of places only a few hundred miles apart. This peculiarity is not confined to any one section. People along the Atlantic sea board think the limitless prairies and the wide open spaces begin on the western side of the Alleghenies. Natives of small communities in the Middle West gaze over their broad and fertile land and complacently compare their living conditions with the wild and hectic life which they believe prevails in the big cities, particularly in the Sodoms and Gomorrahs of the East. To them the South still is the land of Uncle Tom's Cabin. The far West is covered with sage brush and inhabited by coyotes, herds of cattle, cowboys, bad men with long moustaches and finger constantly on the trigger; with stage coaches and covered wagons and with the air constantly permeated with the acrid smell of burning gunpowder. Out in the real West, where according to popular tradition men are men and women are stars of the first magnitude, the native sons refer to everything on this side of the Rockies as eastern. New England is a foreign country almost as nebulous and intangible as Europe."

"Never mind the sermon," I said, "*what every young man should know* and all that jolly old kind of *hooey*. Come down from your transcontinental perch and tell us something of the old town and its people. Surely you must have met some of the old gang and had an hour or two going over some of the events and incidents that kept us going day and night in the glorious and rose colored times when we were twenty-one."

"Well," said Bill, "I'll tell you. There ain't no such animal as the old gang any more. Most of the members left the town years ago and the remainder have settled down to a more or less humdrum existence. I had an interesting hour with a lad who at one time had played the solo alto horn in the old Silver Coronet Band. He has not played for years, but we had a great time recalling the slips and failures, the fights and petty squabbles that characterized practice nights in the band room. Boy! We had some rousing times there. I nearly had a fit when he showed me a group picture of the boys all dressed up in their monkey suits and peak caps and with every man holding his instrument well to the fore.

"Shortly before the train left and while I was engaged in taking a few steps up and down the platform I noticed a middle-aged bird giving me the eye. Something vaguely familiar in his appearance impelled me to try a friendly grin and when he did the same the recognition was mutual. I don't know by what particular mark he spotted me, but the instant he showed his crooked teeth my mind flashed back to a day more than 30 years ago when the same teeth had grievously bruised my knuckles in a trivial argument over the ownership of a water pail. He left the shop before he had finished serving his time and joined the mob that at that time was streaming toward the Klondike. I never heard of him afterward although occasionally I had speculated idly on whether he had found the pot of gold or had been converted into an icicle. Somewhat to my surprise I learned that he had settled in British Columbia where he had learned the trade or profession or whatever it is of a brakeman. Eventually he had blossomed forth as a conductor, a posi-



HOOT MON! THE CAM'ELS ARE COMIN'

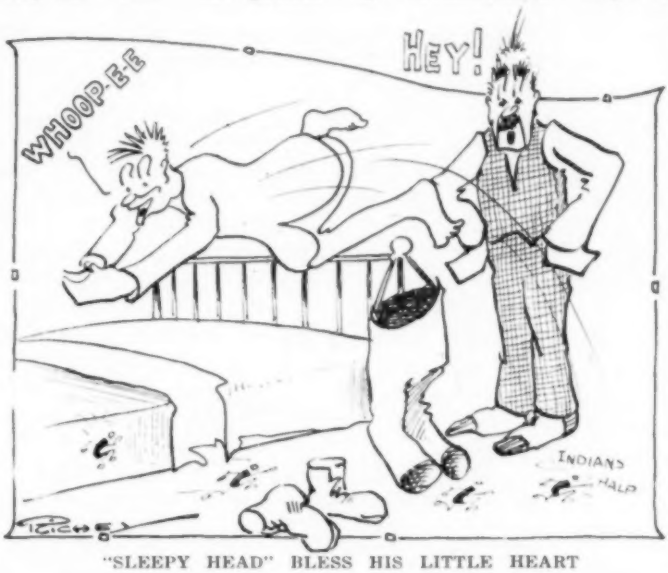
tion which among other privileges and emoluments entitles one to free transportation. Quite a help when one starts out on a 3000-mile jaunt."

"What's the idea of dragging this lad into the story?" I said. "He was only a chance acquaintance. Just a touch and go meeting. I don't know him and you never may meet him again."

"Tut, tut," said Bill, "try to control the emotions. Don't grind your teeth. They will wear out soon enough. In a word, be calm. Listen. The reason I mentioned this lad is because unconsciously on his part he reminded me of an experience which at the time covered me with confusion, embarrassment, blushes, hot and cold sweat or what have you. I can laugh over it now, but believe me, at the time I gladly would have exchanged places with any victim at the stake and considered myself the gainer." "What happened?" I inquired. "Did he steal your clothes or your girl or did he stand brazenly in front sucking a lemon while you tried to run the cadenza of *Afton Water* on your old key bugle?" "At one time or another," said Bill, "he was directly responsible for all these things, but in this particular instance he was only indirectly to blame. Over one week end followed by a holiday on Monday he invited me to accompany him to his parent's home located near the mouth of a noble river where it flowed into the harbor. The primary object of the journey was to shoot wild geese which lingered along the coast for a short period in the spring on their way to the far northern breeding grounds. In passing I might say the birds must have heard we were coming, or for some goosey reason they made a detour. We never saw a feather. However, that is beside the point and has nothing to do with the incident that made me feel sillier than any goose wild or tame.

"This was my first excursion away from home overnight and as I only found it necessary to indulge in a modest shave once a week in those days I saw no necessity for cumbering myself with a traveling bag. I debated with myself long and earnestly whether I should take my night shirt. On the one hand I dreaded the ribald jeers of my companions if they once suspected the contents of the package under my arm. On the other hand I dreaded still more the secret comment of my host and hostess if they learned that their son's guest slept at night without this intimate garment. Hot waves like an alternating current flowed from my toes to my ears as in imagination I heard the family circle dissecting me after my departure.

"If I had been sure of a private room I would have taken a chance without the thing and trusted to Providence. However, I was afraid I would be paired off for the night with the son and then my shame would be exposed to the world. Finally, I decided to stuff the garment in the inside pocket of my overcoat and then be guided by circumstances whether I should or should not wear it.



"SLEEPY HEAD" BLESS HIS LITTLE HEART

"Did you ever try to stuff a flannellete night shirt into a coat pocket? It simply can't be done. I wrestled over the job for an hour. At one time I was tempted to put it on and then don the remainder of my clothing over it. A little calm reflection shot that idea all to pieces. It was too long and if I rolled it up I should look like Santa Claus. Also the hot and cold flashes warned me of what would happen if my friend viewed me disrobing *down* to the night shirt. After a long and valiant struggle in which I tore the pocket I managed to wedge most of the garment inside, but I had to let the sleeves dangle. After I put on the coat I bore a striking resemblance to an absent minded camel whose hump had slipped around in front and slightly to one side.

"I removed the coat immediately after we entered the house and thus escaped detection temporarily. I manfully resisted the well meant offers of my hostess to take the coat and hang it up. I hung on to it desperately like a dog with a bone and at the same time burned up inwardly at the realization that the assembled members of the family probably were secretly appraising me as a rare form of bug. My condition was not improved by the presence of a beautiful daughter about 18 for whose favor I gladly would have sacrificed 40 overcoats. Her occasional giggles and shyly veiled glances earned a discreet maternal frown, but they were so many points of flame to my naked and tortured soul.

"Bitterly I reflected that upon entering the house I should have made an excuse to dash upstairs. There I might have hung the coat on a hook, face in, and my guilty secret would have been safe from prying eyes until bed time. The longer I remained in the parlor the more difficult I found it to hatch up any reasonable excuse for retiring. I sat there, glued to the chair, trying to look pleasant and afraid to move lest one of the dangling sleeves should peep coyly into view. Finally when I was on the point of collapse the lady of the house retired to the kitchen to look after the evening meal and I suggested to the son that I should like to go upstairs to kind of touch up the old map and make myself presentable. In his good-hearted clumsy way he assured me I was alright as I was. The family did not observe any ceremony, but I insisted. I hugged the misbegotten coat closer than a brother and no man suddenly snatched from the hangman experienced more relief than I did after I had hung the garments in a closet.

"When the time came for retiring I found myself in a worse predicament than ever. Just as I had feared, I was paired off with the lad for a bed fellow. I discreetly hung back while he was undressing so that I might see which way the cat was going to jump. The lad was a swift actor. He stripped off all his clothing with the exception of a wool undershirt, threw them all over the floor and then with a yell like that of a wild Indian he made a flying jump into the bed, curled up and pulled the bed clothes over his head.

"Manifestly if he was accustomed to sleeping in that primitive manner I could not outrage all the laws of hospitality by any such high hat procedure as donning a night shirt. I shuddered in agony in anticipation of

the story he would circulate gleefully in the shop on our return. I more than half suspected that none of the other members of the shop crew ever indulged in such an effeminate garment. With the perverted sense of humor which characterizes these hardy birds I realized how they would seize upon the incident to keep me in perpetual purgatory. In mortified imagination I could hear the sly jests, the innuendos, the coarse jokes and allusions to little Willie and his nightshirt. Life would not be worth living. I also stripped down to the undershirt and crept into bed.

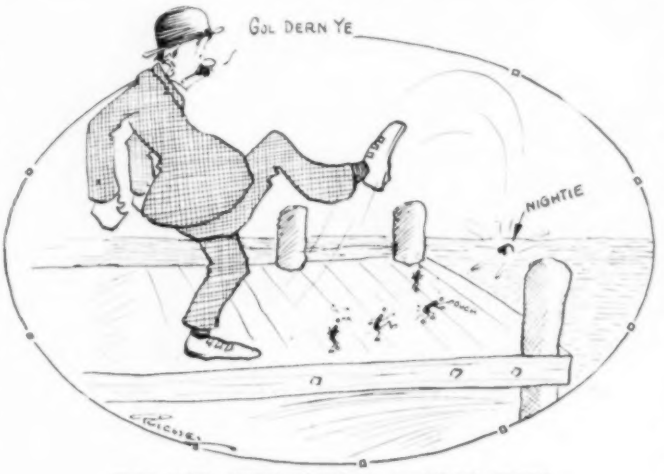
"At breakfast the following morning we had fresh herring. I never had eaten one of the loathsome creatures. I always had disliked their appearance and I could not endure their perfume. I had been brought up in a fairly free and easy household and therefore unfortunately never had been forced to eat things I did not like merely because 'they are good for you my dear.' Here it was a case of acting the hero even if I died for it, or of attracting further unwelcome attention. Heaven knows I already felt sufficiently conspicous. I managed to snaggle through a pair in the manner of a bewildered sheep struggling through a patch of raspberry bushes. 'Twas a tough ordeal, but I emerged alive. For weeks afterward whenever I felt a slight itching of the skin on any part of my body I expected to find one of the 2,000,000 herring bones working its way through."

"Never mind about the herrings," I said, "finish the tale of the shirt."

"Desperate diseases you know," said Bill, "and all that kind of thing. I hastened down to the dock in advance of the others, snatched the cause of all my agony of the pocket, wrapped a big cobble stone in the center, tied the two arms around it in a double bowline hitch and then viciously threw, not dropped, mind you, but threw it into about 7 fathoms of water. I hoped some large fish would swallow it and die in great agony.

"This here now habit," said Bill, "of rushing into a thing without proper knowledge or preparation reminds me of a letter I had recently from a lad in the rural districts who proposed making a few castings in a blacksmith shop.

"He wrote that he had a blacksmith and general repair shop and occasions sometimes arise where new castings are required and he could make them if he had the necessary knowledge and equipment to produce them. He was not familiar with foundry practice and would appreciate information on the following points: 1—Are castings always made in sand molds from a pattern, or can they be made in metal molds without a pattern or sand. 2—What would be the approximate cost of building a cupola to melt about 200 pounds of metal. He could get an old boiler shell for $10 or $15. All he needed was the other parts. 3—Should he have two cupolas, one to melt about 50 pounds and the other to melt 200 pounds. Occasionally he might need to make several castings at the same time. 4—Send him a list of books containing all the information necessary to build a cupola, make patterns and molds and how to melt cast iron, steel, semi-steel and malleable iron.



THE BOY SURE SHAKES A MEAN HOOF

"How's that for an order? I told him that his ambition was commendable, but I thought when he began to realize something of the magnitude of the problems he presented he would see the utter impossibility of attempting their solution single handed in the course of an ordinary life time.

"The manufacture of castings is a highly specialized and highly developed business and I was afraid he was laying himself wide open to a lot of grief and disappointment by adding a casting department to his blacksmith and repair shop. However, I would not presume to dictate any man's own policy. I said he could draw his own conclusions from the following answers presented in the same order as the questions.

"1—Castings are not made always in sand molds. Many castings are made in metal molds, but only a highly skilled foundryman, one who has devoted special attention to the subject can determine whether a metal mold is advantageous for any given casting. The subject was too extensive for a casual discussion. For an illuminating description I suggested he should consult issues of THE FOUNDRY for Oct. 1, 1925 and Jan. 15, Feb. 1, Feb. 15 and March 1, 1926 dealing with one or two phases of the subject.

"2—If he did not expect to melt more than a few hundred pounds he did not need an old boiler shell for a cupola. Probably he had them himself. If not he could go to the nearest garage and filling station and get a couple of empty oildrums. He could knock the heads out, stand one on top of the other, cut a tap hole in front and two tuyere holes opposite each other and about 6 inches above the bottom in the lower drum, line the drums with fire brick set on end, attach a pipe to the forge blower and melt a few hundred pounds of gray iron any time he liked. 3—From this question I gathered that he was under the impression that a cupola is loaded with a definite quantity of metal which is all melted and poured at one time. I explained that a cupola will continue to melt indefinitely as long as fuel and iron are charged into it. Thus the one cupola in this case might be employed to melt 50 or 500 pounds of iron.

"Small quantities of gray iron may be melted without any great amount of trouble or expense, but the same is not true of malleable iron or steel. A person with sufficient technical and chemical knowledge can melt a certain grade of malleable iron in a cupola, but additional equipment is required afterward to anneal it. This is a ticklish process, altogether outside the province or capacity of an amateur.

"Steel is even more difficult and costly metal to handle. It cannot be melted, or, to be strictly accurate, molten steel cannot be tapped from a cupola. If steel is charged into a cupola it can be reduced to a molten condition, but during the process it absorbs carbon from the fuel and no longer is steel. The metal tapped from the spout is a species of white or gray iron.

"Four methods are in use for melting steel, crucible, converted, open-hearth and electric furnace. Any one is too expensive to install and operate for the sake of making an occasion casting."

How and Why in Brass Founding

By Charles Vickers

Casts Aluminum Trays

We are trying to cast aluminum alloy trays about 3 x 3 feet by 15 inches deep, of which we send you a sample for inspection. Will you please advise us the temperature at which the castings should be poured as we use a pyrometer? Also at what temperature should bronze bushings be poured, and also bronze dies which are about 12 inches diameter and ranging from ⅜ to ¾inch thick?

As the metal thickness of the tray is 5/16-inch it may be necessary to pour it at a dull red heat, which is around 1300 degrees Fahr. If there any possibility of completely filling the mold with metal at a lower temperature, this should be always done. The lower the pouring temperature is that gives perfect castings the better those castings will be in the case of aluminum alloys. Much depends on the manner of gating. A flat piece like a pan, gated along the sides with flat gates and runners has to be poured with metal much too hot for the sides to avoid cold shuts in the middle of the bottom, for such a casting would always be made bottom up. If, however, one has the strength to ignore tradition, the casting can be gated by means of *pencil gates* distributed uniformily all over the bottom. These gates should never be thicker than a lead pencil, if as thick, and they should be set upright regularly all over the pattern. The runners connecting such gates should be cut on top of the cope, well thumbed, and be smooth and clean. They should be covered with a false cope carrying the sprue, which of course only drops into the runner channels on top of the cope. The writer has made thousands of aluminum alloy castings in this manner.

We offer this as a suggestion: Enter the metal by many gates, and limit the flow to permit cool pouring. Do not overheat the metal when it is in the furnace; a dull red should be the limit while filling the pot, as the sample shows it is crucible poured metal.

The pouring temperature of bronze bushings is unimportant. It will vary with the pyrometer, with the manner of gating and molding, and with the size of castings. The same remarks apply to the dies, do not blame the metal, or its pouring temperature for faults due to ignorance of the proper facing sand or the proper gating and venting of the molds.

Surface Is Porous

We are making quantities of aluminum alloy castings and on finishing them we often discover the finished surfaces to be porous. We have been unable to remedy this condition and would appreciate any information you can give us in regard to the addition of some white metal to the aluminum that will eliminate the holes without changing the appearance, or materially adding to the weight of the castings.

Tin is the only white metal that we know of that has the reputation of eliminating the holes mentioned. It is necessary to add around 10 per cent to get results. Naturally such an addition of an expensive element will increase the cost of the aluminum alloy, also its specific gravity. Tin will not harden the alloy neither will its addition increase the physical properties of the aluminum alloy.

A considerable improvement may be expected in regard to this pinholing if the alloy is poured at low temperature. Possibly this point has been overlooked. The use of a pyrometer is always advisable when pouring quantities of aluminum castings and at the start of the work the first thing to determine is the correct pouring temperature. It is not advisable to pour too many molds in a string from one pot or ladle, because either the mold first pouring gets metal too hot, or the last one poured gets metal too cool and the mold may not be filled fully. Pouring temperature always has to be adjusted to the particular casting that is made. Pour at as low a temperature as possible, record it by pyrometer and then pour all castings at this temperature. Also if melting in crucible keep the temperature of the metal in the pot down by constant additions of cold metal until it is filled. Then bring to the proper heat for pouring. This temperature will be a little above the mold side temperature to allow for slight losses.

Studies Temperatures

We are having some trouble making castings to withstand water pressure and expansion. The alloy is known as composition M, and the difficulty is to keep the castings from drawing or shrinking at the points indicated in the sketch we enclose. It appears to us that the temperature of the metal has more to do with this than anything else and we desire to know if you can inform us as to the correct melting and pouring temperatures for this alloy. Also, is there a treatise published dealing with the pouring temperatures of the various alloys?

Composition *M* as we understand is specified as copper, 87 per cent; tin, 7 per cent; lead, 1 per cent max.; iron, 0.06 per cent max.; and zinc, remainder. A convenient pouring temperature for this alloy in the case of castings such as shown in the sketch is 2100 degrees Fahr., minimum. The temperature of the metal when poured is important, for if it is not sufficiently fluid it may fail to fill the molds, or even if it should do this it solidifies before there is any chance to shrink normally and draw metal to fill up pappy spaces from supply in the *heads* provided for that purpose.

Pouring temperature is far from being the most important matter in making sound bronze castings, and no doubt in this particular case the pouring temperature of the metal has been varied within all possible limits. It is necessary to pour all steam metals at such a temperature that it will not string from the lip of the pot or ladle, to be accidentally dropped down the sprue of the next mold when maneuvering for pouring position. The most important thing is to have the proper amount of hydrostatic pressure on the molds, and in this regard it is always well to lean a little to the side of too much than of too little.

Our suggestion is to jump the heads up on the molds, either by *upset* or by a bushing and do not be afraid of putting a little metal into the sprues and the gates, or runners in order to have normally dense metal in the castings. The molding sand should also be free and open; not necessarily coarse, but of such texture the steam and other vapors can escape.

Apprentice Training Course *Makes Molders*

Results Secured Are Stated To be Due to the Attitude of the Foreman, Designing of Equipment and Close Supervision Over the Work of the Apprentices

By Paul R. Ramp

ADHERING to the principles, advocated and practiced by educators throughout the country, that a person can learn more rapidly by using the methods of seeing and hearing at one and the same time we have established a lecture course for all our foundry and pattern shop apprentice boys. These boys convene in a special lecture room for a demonstrative lecture, on the different phases of their work, every Wednesday afternoon 40 minutes before quitting time.

The big problem is to formulate plans which will result in the maximum amount of information the boys can absorb in the minimum amount of time. For instance, we may discover that there is an epidemic of bad castings. The defective castings may be due to the gating, ramming, clamping or coreing up of the molds.

If improper gating is causing the loss, we demonstrate the correct procedure by making a mold and cutting the gates, and explaining in detail the *why*. The result is amazing in many instances and even though only 50 per cent of the boys in the class may absorb the content of the lecture, we know that there is a great saving effected. I believe that to see the work properly done and to hear from an experienced foundryman why it is done is worth more to an apprentice boy than the reading of ten volumes on the subject.

In a foundry where standard work is being done at all times, perhaps it is not necessary to have as many lecture hours as we do, but since our work is so diversified, it is highly important to instruct each boy in the way new methods obtain cheaper and better castings, instead of letting him learn how the old molder is doing it with methods employed by our forefathers.

What some foundries need today is new blood, bringing with it new methods the result of time, study, science and invention. They need molders who know exactly why they do a thing, and when to do it. They need men who regard their craft as a profession, the knowledge of which renders their work an art.

In teaching young men how to mold, we do not simplify the methods to make it possible for them to do the work, but because we want to teach them the best and the cheapest methods. We would not make much progress if we taught a man how to make a mold in the same manner it has been made during the past 40 years, if there were a better and a cheaper way to do it. For this reason we spend a great deal of time deciding upon the best practice before attempting to teach the apprentice.

For example we had been making turbine casings in loam for a nummer of years. Three weeks and sometimes longer were required to get one of these molds ready for the oven. We built a flask, made some alterations in the pattern and taught two apprentice boys how to ram and finish this mold ready for the oven. As a result of the improved method and the young men's enthusiasm, the work was done in 3½ days instead of 3 weeks. The ramming and finishing of this first mold was supervised by a foreman who was qualified to teach the boys every detail. He was a good mechanic himself, and best of all, he believed in boys and apprentices.

For us to say that these boys are proud of what they have accomplished and that they love their work would be putting it mildly. While the improved methods with the new equipment were advantageous, the foreman who believed in ability of the boys was directly responsible for their success and for their attitude toward their work.

The cores for these molds were of an intricate character and they had always been made without any consideration of modern methods. Consequently, a first class coremaker of the old school was required to make them. To improve this condition the large cores were cut into smaller pieces, and the proper division made in the more difficult ones. The result was that the entire set of cores was produced successfully by apprentice boys. When the first set was made, half the cores were scrapped and made over, and the remaining pieces were none too good, but the second set and all following sets were first class cores produced at a much lower cost than by the old method. This was due largely to the creation of a spirit of enthusiasm in the young men doing the work.

Teaching the boy the *why* of molding is what gets results in the jobbing foundry. If care is exercised

Teach the Boys Why

Getting away from the old fashioned hit or miss four-year course in which a boy picked up a trade as best he could, a method by which boys are taught intensively the why of the various operations was the subject of a paper presented by Paul M. Ramp before the convention of the American Foundrymen's association Sept. 27-Oct. 1. By following his method he claimed he had boys as competent as many journeymen after a year's training period. To facilitate the work those in charge of the various foundry departments analyze every job before it is commenced in the pattern shop. They suggest any necessary changes to simplify succeeding operations. Equipment is provided to speed the work and so far as possible reduce the natural hazards incident to preparing a mold that will serve its appointed purpose satisfactorily. The author, Paul M. Ramp, comes from a family of prominent foundrymen. He has had a wide experience as foreman, superintendent and manager of foundries for many years. At present he has charge of the foundry department of the Newport News Shipbuilding & Drydock Co., Newport News, Va.

FIG. 1—APPRENTICES FROM THE PATTERN SHOP AND FOUNDRY ARE ASSEMBLED ONCE A WEEK FOR AN HOUR TO LISTEN TO PRACTICAL TALKS AND WITNESS DEMONSTRATIONS. FIG. 2—DRY SAND MOLD FOR A TURBINE CASING MADE IN A FLASK BY TWO APPRENTICES

in selecting these young men it will be found that it is not necessary to let them linger along in the *A B C* of molding. The plan of allowing the apprentice boy to help around the shop for a period of years to familiarize him with details before he begins to mold, or keeping him on simple work for several months is wrong. If the boy is going to make a mechanic, if he has the stuff in him, we should work fast if we are going to get him not only interested, but enthused in the work.

The idea that we can advance the boy too rapidly originated with the foundrymen who did not have the time or inclination to teach a boy details connected with making difficult castings. He was content to let the apprentice drift until he had served 4 years at molding and then demand a day's work for a molder's pay. Usually the 4 years apprenticeship was almost wasted unless the boy was exceptional.

Fig. 4 shows a 30-ton gear center for a large passenger ship. The young man on the right is an apprentice boy, who was taught the *why* of molding. He built the loam mold, put it in the oven to dry, placed the cores, closed the mold, made the necessary runner basins and riser heads and assisted in pouring. There was not a blemish on this, nor on others which he made. This young man has been working less than three years in the foundry. This is more evidence of what *job analysis* or *intensive teaching* will do.

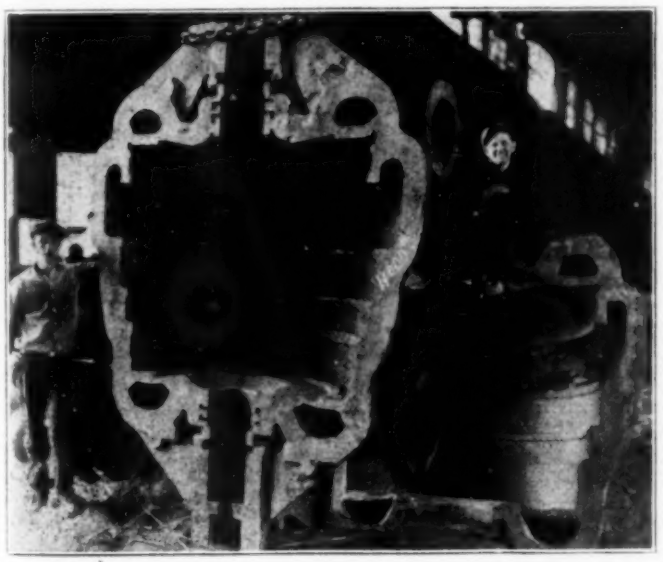
Loam Molds Made by a Youngster

A good illustration which helps to prove that detailed instructions make the usually considered difficult molds simple is shown in Fig. 5. This young man is shown sweeping a loam mold for a condenser cover. He is not helping the molder or carrying the brick; he is doing it alone. The quicker we put the boy to working alone the quicker we get results, the faster he grows in ability, and best of all, the more he loves his work. This young man has been in the foundry for about six months, and several times he has done a bigger day's work than some journeymen.

We have 22 apprentices in our pattern shop, with only a few who have worked more than one year making patterns. Regardless of this fact they are able to produce large, difficult patterns sometimes at a lower cost than the same patterns were made previously by journeymen patternmakers. The reasons we believe that we have been successful in this undertaking is because the young men have been taught the *why* of everything they do. This makes it possible to produce a high grade mechanic in a short time.

The old plan of spreading the boys out among the journeymen and letting them absorb what they could in a course of four or five years leaves much to be desired. While they are absorbing some of the fundamentals from these old men, they are learning at the same time, probably unconsciously, how to beat the boss, and learning to consider him as their enemy rather than their friend.

In the shop it is sometimes amusing to hear an old mechanic refer to another workman in this manner: "Oh, he is only a handy man." The second man probably has worked at



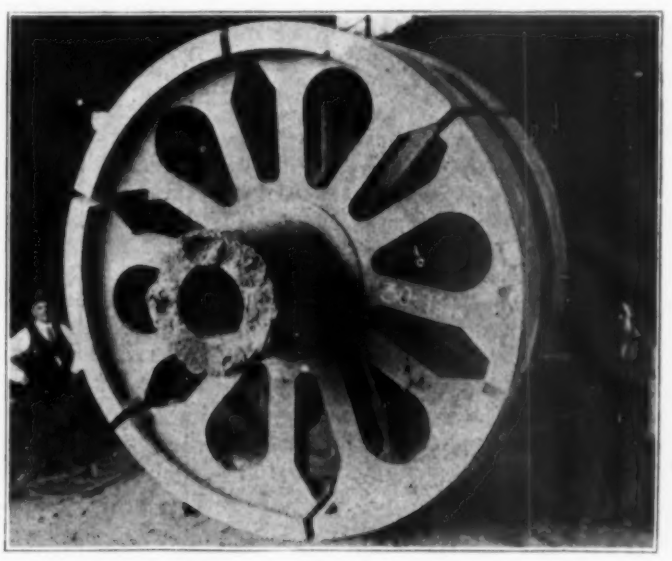


FIG. 3—ONE OF THE CASTINGS MADE IN A MOLD SIMILAR TO THAT SHOWN IN FIG. 2. FIG. 4—A 30-TON GEAR CENTER FOR A LARGE PASSENGER SHIP MADE BY A YOUNG MAN WHO HAS BEEN WORKING AT THE TRADE FOR LESS THAN 3 YEARS

FIG. 5—THE YOUNG MAN SHOWN SWEEPING THE LOAM MOLD OR A CONDENSER COVER HAS BEEN IN THE FOUNDRY LESS THAN 6 MONTHS AND ON SEVERAL JOBS CAN DUPLICATE THE WORK OF A JOURNEYMAN

the trade for 10 years and the only difference between the two is that the second started as a handy man instead of an apprentice.

In our pattern shop we have a monthly report on apprentices shown in Fig. 6. From daily information on this report the apprentice boy is given his monthly average. This average is made up as follows: For absence he is charged four points; for being late, two points; deportment, he gains two to four points; tools, two to four points; neatness, two to four points; work, two to four points; slow, two to four points; loafing, two to four points; aptness, two to four points.

Every day the boy's card is marked up according to his performance. The item tools refers to how sharp or how clean they are; neatness, the condition of his time cards, his bench, and his personal appearance; errors, refers to mistakes in his work; work, means the quality of the pattern he produces; loafing is visiting with other boys; apt is the manner in which he absorbs instructions; slow means below the average workman. These reports create a great deal of interest as this percentage is posted in the shop monthly and the boys watch for the report and often fight for what they consider their just dues. If they have a good average, they go home and tell their parents about it.

We also have the boys' work benches numbered. The boy who has the best average and is making the most progress is entitled to work at bench No. 1, or have his own bench numbered one; the boy next in line is entitled to bench No. 2, and so on down the line. This also has a tendency to make the boys strive for a low bench number.

Training apprentices is not always a bed of roses, especially in the old established shop. Someone has said that the day of the skilled The only difference is that the day has come when it requires much shorter time to develop the skilled mechanic is past. This is a mistake. methods of instruction in the shop.

Some are under the impression that the only place where mechanics can be developed who can produce good patterns or good castings in a shorter time than 4 years is in the specialty shop where their work becomes more or less a habit. This is also a mistake. We have found, that with the right kind of men instructing the young men in *why* they do things and *what* would happen if they did not, that mechanics can be trained for the jobbing shop. The best plan is to train your own men to be instructors. This gives you an opportunity for selecting the men with the proper temperament for the work.

NEWPORT NEWS SHIPBUILDING AND DRY DOCK CO.

SHOP REPORT ON APPRENTICE_____ CHECK No._____

FOR MONTH OF_____192__

DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	AVERAGE
ABSENT																																
LATE																																
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TOOLS																																
NEATNESS																																
ERRORS																																
WORK																																
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AVERAGE																																

REMARKS:

INSTRUCTOR

FIG. 6—FROM THE DAILY INFORMATION FILED ON THIS REPORT CARD THE APPRENTICES IN THE PATTERN SHOP RECEIVE THEIR RATING

Utley Proposes Fairer Prices for Castings

(*Concluded from Page* 426)

foundryman stops to think that this cut means less than 7 per cent on the total price to the buyer, he will at once realize that such cutting is poor business."

Another point which Mr. Utley mentioned in his plea for a firmer attitude toward a reasonable price for castings is the custom of a great many foundries to make no extra charge on extra quality or service. He pointed out that such extra quality and service should call for premiums above regular prices, and said that no buyer can be expected deliberately to insist on paying premiums and that foundrymen can get the higher prices justified only by insisting on them.

Low prices do not increase the use of castings. More castings are bought when prices are rising or when they are high than when the prices are low or falling.

Sells Battery Branch

Prest-O-Lite Co., New York, has sold its storage battery branch to the Automotive Battery Corp., New York, who will operate it under the name of the Prest-O-Lite Storage Battery Corp. The Prest-O-Lite Co. will continue the manufacture and sale of acetylene gas, generators and other apparatus.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

A LEXICON OF TECHNICAL TERMS

By O. W. Potter

(*Continued from Data Sheet No.* 668)

Absorption

The property of being able to absorb considerable quantities of gases. Wrought iron, steel, and malleable iron absorb only small quantities. White iron absorbs more than steel. Gray cast iron is the most absorbant of the group.

This property of absorption of gases in cast alloys is receiving more consideration than formerly. It is believed that many of the variations in physical properties and difficulties encountered in the cast alloys are due to the dissolved or absorbed gases.

Corrosion

Corrosion is defined as the slow oxidation or wasting away of a metal. It usually is considered at ordinary temperature but may also be considered at high temperatures. The property to resist corrosion or the resistance to weathering agents, is the measure of the *noncorrosive* properties of metals and alloys.

This is an important property in connection with most engineering materials. There are many causes but the exact mechanism of its procedure is not definitely known. Temperature, atmospheric conditions, the presence of certain gases, moisture, and electricity all are involved to varying degrees. To make alloys and metals more resistant to corrosion it has been found that protective coatings are satisfactory. It is noted that pure metals are less subject to corrosion than its alloys in general, although some special alloys such as silicon iron, and high chrome irons and steels are especially noncorrosive.

Decrepitation

The property of certain substances to fly apart (explode) with a crackling sound on being heated. Alloys of the iron carbon series do not exhibit this property to any extent.

Distillation Properties

When a liquid is vaporized and conveyed to another container of lower temperature and the vapor condenses again to a liquid, the process is called distillation. The vaporization temperature is so high for the iron-carbon series that this property has not been determined easily.

(*Continued on Data Sheet No.* 672)

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 671)

Passivity

The property of not being affected appreciably by the action of ordinary corrosive agents. This usually is referred to metals or alloys that have been given some treatment to prevent the corrosive action. For example, if iron is immersed in concentrated nitric acid, and then subjected to other corrosive agents which ordinarily attack iron quite readily, it is found that the iron remains almost unaffected.

Solubility

The chemical property of dissolving in a liquid. Solubility in water varies greatly with the composition, wrought iron and cast iron being much less affected than the steels. Some of the alloy steels such as copper steel, chrome steel, silicon steel are classed as noncorrosive even in acids and alkalies. Further reference is made under chemical analysis and corrosion properties. The properties listed are for relatively pure iron:

None in pure water. Considerable in polluted or alkaline waters. Readily soluble in the common acids.

Sublimation

The property to form a solid direct from a vapor without first passing through the liquid state. This property has no particular application to the iron carbon series. The most common examples of this phenomena are antimony (Sb) and arsenic (As).

Plasticity (Viscosity)

The property of sustaining permanent deformation without rupture; the opposite to elasticity or resiliency.

Steel and wrought iron are plastic.

White iron and cast gray iron are not plastic.

It is upon this property largely that it is possible to cold and hot work (rolling, forging, etc.) the steels.

Ductility

The capability of being permanently deformed without rupture by tensional forces. Ductility is ordinarily understood to be cold deformation but *hot* and *cold* ductility are sometimes used in contradistinction.

Çito-ductile is applied to a substance which can be stretched suddenly without rupture.

Wrought iron and steel are ductile.

Cast iron is not ductile.

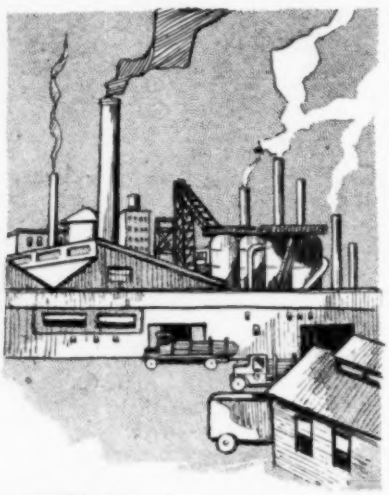
Pure iron is fourth in the ductile scale.

(*Continued on Data Sheet No.* 673)

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

Seeing America with The Foundry

Little Journeys to the homes of our readers



INDIANA has a total of 229 foundries of which

163 Melt Gray Iron
12 Melt Steel
17 Melt Malleable Iron
48 Are Exclusive Brass
59 Have Nonferrous Departments, and
88 Melt Aluminum

INDIANA had its first permanent white settlement in 1734 by emigrants from Canada. However as early as 1680 La Salle had made explorations in the Ohio and Wabash valleys, and early in the eighteenth century trading and military posts, missions and settlements had been made at many points.

The state in addition to having important manufacturing centers has a total mineral output in excess of $42,000,000 in value annually. Many mines yield an excellent quality of bituminous coal; the output is steadily increasing, and now exceeds $19,000,000 in value yearly. The petroleum industry is important and the state ranks first in the production of lime and second in the production of Portland cement. The output of building stone is of great value and brick and tile clays are widely distributed over the state and give rise to important industries.

Hammond, East Chicago, Indiana Harbor and Gary are important manufacturing centers near Chicago and form practically a continuous manufacturing district around the southern end of Lake Michigan. Gary has the largest steel works west of Pittsburgh. There are numerous factories for the manufacture of agricultural implements, automobiles and other wares. All the important cities are joined with a network of interurban lines and bus service and Indianapolis has the largest interurban station in the world.

For serving these industries there are 229 foundries established.

In INDIANA—THE FOUNDRY has 368 paid subscribers

"Wherever metals are cast you'll find THE FOUNDRY"

Milestones in Foundry Progress

As Recorded in the June Issues of THE FOUNDRY, Thirty, Twenty and Ten Years Ago

1897

THE FOUNDRY for June, 1897, carried a complete description of the second meeting of the American Foundrymen's association. This convention, held in Detroit in May, marked the first organized exhibition of foundry equipment and supplies. The papers discussed ranged in subject from the care of crucibles to the value of chemistry in the foundry. A membership of over 480 was reported by the secretary, John A. Penton, despite the handicap of a national election and a severe business depression. The society was just one year old, but it was firmly intrenched and ready to start its work for the welfare of the foundry industry.

* * *

The desirability of a uniform apprentice training system was discussed.

* * *

Plans were laid for the formation of a national employers' association built along the lines of the Stove Founders' National Defense association, following a report by W. H. Pfahler, Abraham Cox Stove Co., Philadelphia.

* * *

This was the preliminary movement that launched the National Founders' association.

* * *

Krank's Korner took a fling at a so-called, pre-heating type of cupola that derived its incoming blast from a chamber set around the outside of the shell. Obviously, but little rise in temperature could be expected from this source.

* * *

RUTHLESS RHYMES

"We're lost," the melter shouted,
As he staggered to the floor,
"Jim lit a match at the air intake,
Now the iron's too hot to pour."

A. V.

* * *

Dr. Richard Moldenke, then of McConway-Torley Co., Pittsburgh and B. D. Fuller, Westinghouse Electric & Mfg. Co. of the same city appeared on successive meeting nights before the Pittsburgh Foundrymen's association to discuss cupola practice.

Faked Foundry Facts

A Clean Skin

Murray Iron Works, Burlington, Iowa was enlarging its plant.

The Chicago Hardware Foundry Co. was just incorporated with a capital stock of $5000 by Earle P. Sedgwick and others.

* * *

An elementary type of mechanical sand riddle was mentioned for the first time.

* * *

1907

PRELIMINARY plans for the American Foundrymen's association convention in Philadelphia, the eleventh since the organization meeting in 1896, were outlined in THE FOUNDRY for June, 1907. A history of the association, written by Dr. Richard Moldenke, then secretary, carried portraits of 61 veterans of the organization. C. E. Hoyt, at present secretary of the American Foundrymen's association then was secretary-treasurer of the Chicago Foundry foremen and was connected with Lewis institute of that city.

* * *

The plant of the Scullin-Gallagher Iron & Steel Co., said to be the largest steel foundry in the world was described.

* * *

Bronze castings for automobile service were covered in a special article by E. F. Lake. The parts mentioned, then made in bronze were gears, axles, levers, piston rods, brackets and bearings.

* * *

Remember the bronze brackets for the polished-brass, oil-burning lamps, and the brass fixtures to steady the windshield, then listed as an extra and paid for as an additional item?

* * *

Langsenkamp-Wheeler Brass Works, Indianapolis, was completing a new foundry.

* * *

A total of 713,157 tons of steel castings made in 1906 marked a new high total for this class of castings.

* * *

The total for 1925, the last figures available, reached 1,252,000 tons.

* * *

Foundry iron was selling at $20 a ton, Birmingham, and $24 to $25 a ton, Pittsburgh.

* * *

1917

BUICK MOTOR CO., Flint, Mich. had completed a new foundry, described in detail in the June, 1917 issue of THE FOUNDRY. Mechanical equipment was featured.

* * *

The first of a series of articles by Charles W. Pack, gave the evolution of the die casting process.

* * *

The upward march of prices already was in progress, ranging from 185 to 370 per cent comparing averages between July 1914 and May, 1917.

* * *

Prices of pig iron also were climbing. No. 2 foundry was bringing $36 to $40, per ton, Birmingham and $43 to $45 in the north. Coke was selling at $9.50 to $10 a ton.

* * *

Charles Vickers, who years previously had been associate editor of THE FOUNDRY, *rejoined the staff as nonferrous editor, a position which he has filled with credit to the publication, through service to the industry, during the past ten years.*

The Shakeout

DAN M. AVEY, Editor
PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor
CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ Capacity—How Measured?

AMERICAN business men are placing increasing dependence upon the figures of production, rates of operations, orders and inquiries that are becoming available in practically every line of commerce or manufacture. These are found, translated in many cases into graphic form in the business press, in newspapers and in publications of various governmental departments and organizations.

In the foundry industry keen interest centers in the department of commerce monthly reports on steel and malleable castings. A glance at these reports for recent months shows that the steel foundries are operating at from 70 to 80 per cent during the past few months, while the malleable shops show from 50 to 60 per cent of their capacity active. On the surface this would indicate a much more prosperous condition existing in the steel foundry than in the malleable branch of the industry; but is this true?

AS IN the case of all statistics, certain basic figures are assumed for comparison, and in these two tabulations, the methods of figuring capacity are at wide variance. In the steel branch of the industry, actual production figures for a previous period are taken as a basis of capacity. In the malleable compilation, the department has a formula which is follows:

Total number of units of molding floor space, times the average production per molder per day per unit of floor space, times number of actual working days in month. In no case should productive capacity based on floor space exceed melting or annealing capacity.

Is not this method almost certain to magnify the capacity of any given plant? Is not the sum of such a series of capacity figures bound to give a result far in advance of attainable totals?

EXCEPTIONAL conditions must govern when every unit of molding space in a foundry is employed even under conditions of maximum demand. Further, melting capacity, even though it may be the limiting factor not always is reliable. For example in a plant with several furnaces, one or more may be maintained in reserve against breakdown, or for relining. Annealing capacity in many cases is not adequate to take care of the maximum tonnage which could be molded, or melted. In other words the unit of molding floor space seems to be entirely out of line with what could be expected as a maximum production for a number of plants, and a comparison of operating rate with this capacity gives the impression that the entire malleable industry is limping along at a low rate. Impressions of overcapacity, or better, underconsumption doubtless, in many cases have their basis in some such assumption of maximum ability to produce.

Would it not be better to base such compilations upon a normal production as given by past performances?

¶ Make It Desirable

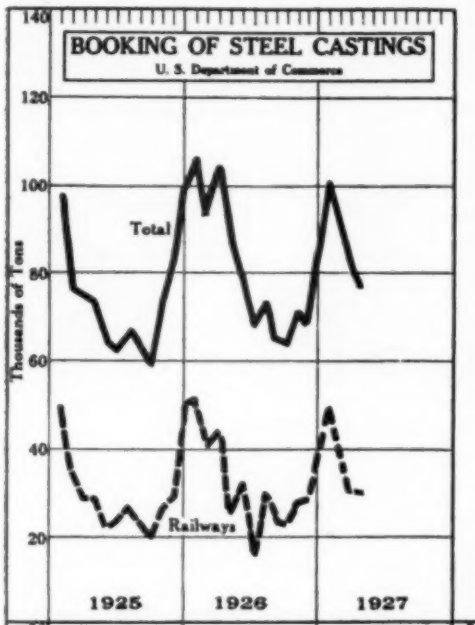
REMEMBER how Tom Sawyer secured the necessary labor to perform the contract of whitewashing Aunt Polly's fence? He made the job desirable. Foundry apprenticeship can be made similarly attractive. It has been suggested, editorially, that advertising in local newspapers might be of assistance in attracting the right kinds of boys. Could not the personal side also be stressed. A number of years ago, the son of one of the executives of a lake steamship company operating boats from Cleveland to Duluth decided, with the advice of his father to ship as a deck hand during his summer vacation from college. He was so pleased with the life on ship board that two of his friends took similar jobs within a few weeks, and by the following summer, they in turn had sold the idea to classmates and at present probably hundreds of young lads are following the inland seas for their summer vacation work. A fair proportion have remained permanently in this class of endeavor and have risen to command some of the huge ore and coal bearing craft. Foundry executives will find it profitable to sell the high character of the foundry business to *their* sons.

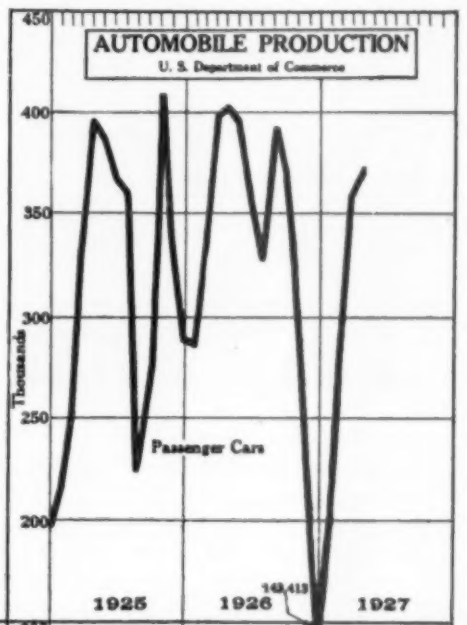
Trade Trends in Tabloid

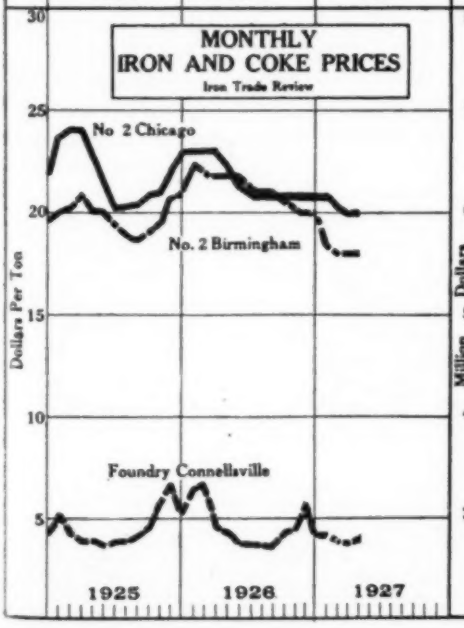
WITH the advance of the summer season, slight declines are noted in orders for general jobbing castings. Automotive demand is spotty. A few cylinder shops are working at top capacity, one operating double shift, while others are slack. General Motors Corp. is said to have placed 80,000 tons of iron for last half foundry requirements, advancing the amount said to have been melted in the first half. Freight car sales have increased steadily in May, with orders within the first two weeks ranging ahead of the April total. Employment figures indicate sustained manufacturing activity in the larger centers, while building construction is holding a fairly high rate. Steel foundries devoted to railway work are slack, in some cases to the point where a shutdown during part of the summer is expected. Malleable activity is slightly improved, sustained by automotive, electrical farm implement and domestic machinery demand. Foundry operations among members of the Ohio State Foundrymen's association declined from 96 per cent in March to 90.6 per cent in April. On the other hand, nonferrous shops picked up from 69.5 per cent in March to 74 per cent in April, in Ohio. Plumbing goods shops report increased orders while the demand for miscellaneous sources is well sustained. Aluminum casting orders are increasing.

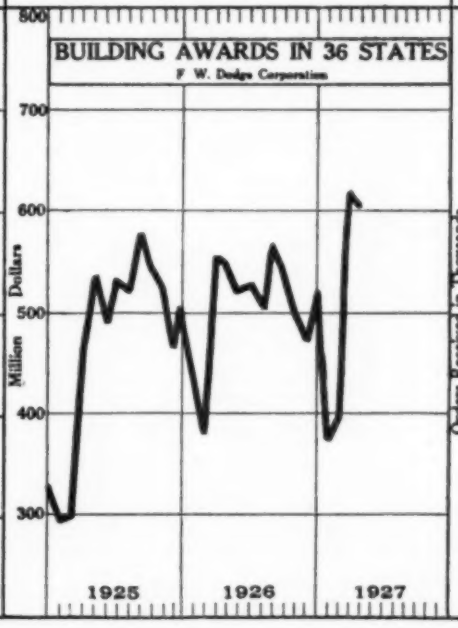
RAW MATERIAL PRICES
May 21, 1927

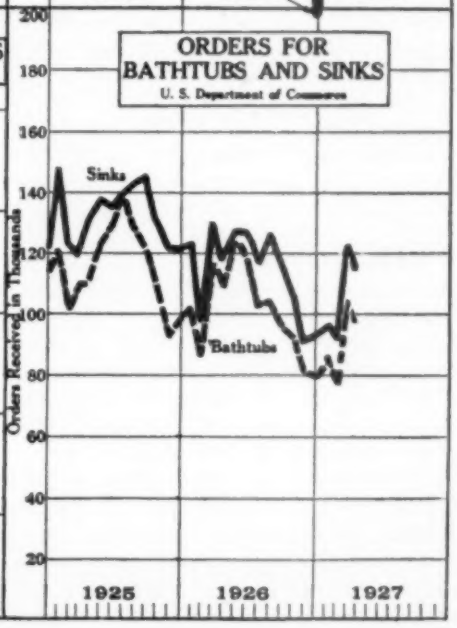
Iron	
No. 2 foundry, Valley	$18.50
No. 2 southern, Birmingham	18.00
No. 2 foundry, Chicago	20.00
No. 2 foundry, Philadelphia	21.76 to 22.13
No. 2 foundry, Buffalo	17.75 to 18.00
Basic, Valley	18.00
Basic, Buffalo	17.25 to 17.75
Malleable, Chicago	20.00
Malleable, Buffalo	17.75 to 18.00
Coke	
Connellsville foundry coke	$3.75 to 4.50
Wise county foundry coke	6.00
Scrap	
Heavy melting steel, Valley	$15.50
Heavy melting steel, Pitts.	15.50 to 16.00
Heavy melting steel, Chicago	12.25 to 12.75
Stove plate, Chicago	13.00 to 13.50
No. 1 cast, New York	14.00 to 14.50
No. 1 cast, Chicago	15.50 to 16.00
No. 1 cast, Philadelphia	17.00 to 17.50
No. 1 cast, Pittsburgh	15.50 to 16.00
No. 1 cast, Birmingham	15.00 to 16.00
No. 1 cast, Buffalo	16.00 to 16.50
Car wheels, iron, Pittsburgh	15.50 to 16.00
Car wheels, iron, Chicago	14.00 to 14.50
Railroad malleable, Chicago	14.75 to 15.25
Agricultural, Mal., Chicago	13.75 to 14.25
Malleable, Buffalo	17.00 to 17.50
Railroad malleable, Pitts.	15.00 to 15.50
Nonferrous Metals	Cents per pound
Casting copper, refinery	12.70 to 12.75
Electro copper, producers	12.87½
Straits tin	68.00
Lead, New York	6.50
Antimony, New York	13.25
Nickel, electro	39.00
Aluminum, No. 12, prod'rs	24.50
Aluminum, No. 12, remelt	18.50 to 19.50
Zinc, E. St. Louis, Ill.	6.05





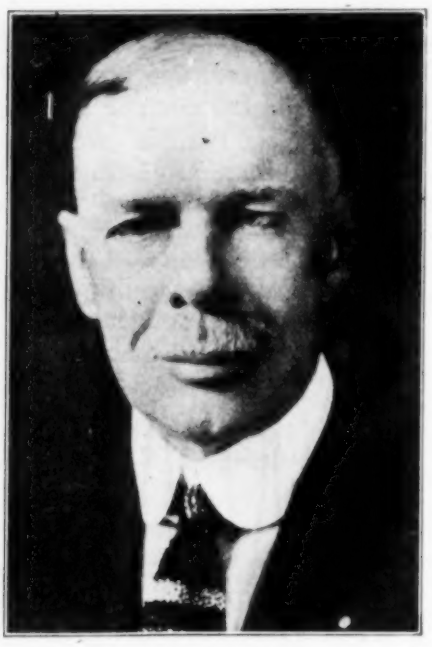






Comings and Goings of Foundrymen

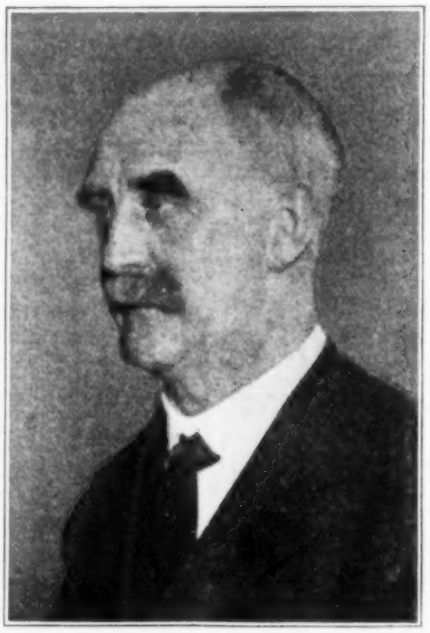
JESSE L. JONES, metallurgist, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is the author of the annual exchange paper which will be presented at the September meeting of the Association Technique de Fonderie de France in behalf of the American Foundrymen's



JESSE L. JONES

association. The title of his paper is "The Effect on the Quality of Pig Iron of the Addition of Iron and Steel Scrap to the Blast Furnace." Mr. Jones received his elementary education in the schools of Martins Ferry, O., and his technical education at Ohio State university, Columbus, O. Previous to attending college, he served an apprenticeship and worked as a molder in the iron foundry of Spence, Baggs & Co., Martins Ferry, O. During his college course he had charge of the experimental foundry of the university. After graduation, he spent short periods as assistant chemist with N. W. Lord, state chemist of Ohio, the Junction Iron & Steel Co., Mingo Junction, O., and the West Penn Steel Co., Pittsburgh. In 1893 Mr. Jones became associated with William Cramp & Sons Ship & Engine Building Co., Philadelphia, as metallurgist. While there he aided in the development of manganese bronze, hydraulic bronze, white brass and other nonferrous alloys. Since 1903 he has been with the Westinghouse organization in charge of chemical and physical testing. Mr. Jones has written numerous papers on chemical and metallurgical subjects. He was elected a director of the American Foundrymen's association in 1925, and at that time also was appointed chairman of the gray iron castings committee. He is a past president of the Institute of Metals division of the American Institute of Mining and Metallurgical Engineers, a member of the American Society for Testing Materials, American Foundrymen's association, and several other organizations.

John Shaw, who for many years has been associated with the Brightside Foundry & Engineering Co., Ltd., Sheffield, England, is retiring from active business at the age of 63 years, and has resigned his position as manager of the Newhall works of that firm. The Brightside company is retaining his services as technical representative and consultant. The directors of the company presented Mr. Shaw with a silver tray, suitably engraved, and the staff presented him with a fitted suitcase. Mr. Shaw is well known in the United States for his many contributions on foundry subjects and was the author of the exchange paper presented by the Institute of British Foundrymen at the second International Foundry convention held at Detroit in 1926 where he appeared in person.



JOHN SHAW

James T. MacKenzie, chief chemist, American Cast Iron Pipe Co., Birmingham, Ala., is the author of this year's annual exchange paper which will be presented at the meeting of the Institute of British Foundrymen

J. T. MacKENZIE

at Sheffield, England in July on behalf of the American Foundrymen's association. The subject of his paper is "The Properties of Coke Affecting Cupola Melting of Steel." Mr. MacKenzie was graduated from the University of the South, Sewanee, Tenn., in 1912, and immediately after entered the service of the American company. He worked in various plant departments and in 1914 was made chemist in charge of melting and mixing. In 1918 he was relieved of routine to devote all his time to experimental and research work. Mr. MacKenzie holds a membership in the leading technical societies and is the author of numerous papers presented before the American Foundrymen's association and other organizations. He also holds membership on several committees of the American Foundrymen's association.

W. S. Hovey, recently elected president of Fairbanks, Morse & Co., Chicago, is the first to hold that office in the company who was not a member of the original Morse family. Mr.

Hovey succeeds C. H. Morse, who retired to become chairman of the board. Mr. Hovey has been associated with the Beloit works for 14 years and has promoted employer and employe relations and plant welfare interests. He also has been identified with industrial safety work. He started with the firm as assistant superintendent of the Three Rivers, Mich., plant in 1902. W. C. Heath, general manager of manufacturing, Fairbanks, was elected vice president in charge of manufacturing.

Joseph B. Deisher, Rochester, N. Y., sailed on May 17 for a 3-months' business trip in Europe. For a number of years Mr. Deisher was connected with the Symington Co., Rochester, N. Y., and for the past 3 years has been assistant consulting engineer of the American Malleable Castings association and the Malleable Iron Research institute. While abroad he will visit malleable foundries in France, Germany, Belgium and England.

JOSEPH B. DEISHER

Frederick C. Fairholme, managing director, Thomas Firth & Sons, Ltd., Sheffield, England, has arrived in this country, accompanied by J. Wortley Fawcett, works manager.

Raymond Gailly, Gailly Freres Malleable Foundry, Charleville, France, accompanied by Mrs. Gailly, sailed from New York May 9, following a 2-months' tour of the United States, including visits to numerous malleable plants.

Arthur Whitcraft has been appointed eastern sales manager with headquarters at Port Ewen, N. Y., by the Kensington Steel Co., Chicago. Mr. Whitcraft has been engaged in the manganese steel foundry industry for the past 17 years including operation using both converters and electric furnaces and sales engineering.

Karl O. Nordahl, who has been employed at the Riverside Steel Castings Co., Newark, N. J., for the past 4 years, will leave shortly on a trip to Sweden. He expects to return in November.

C. F. Messinger, vice president, Chain Belt Co., Milwaukee, and a director of the Federal Malleable Co., Milwaukee and the Nugent Steel Castings Co., Chicago, has been made vice president of the Stearns Conveyor Co., Cleveland.

O. W. Potter, since 1919 associated with the University of Minnesota as an instructor of various engineering subjects and foundry practice, has obtained a leave of absence and is now manager of the Winona Machine & Foundry Co., Winona, Minn.

Alexander McCarte, foundry manager, E. & T. Fairbanks & Co., St. Johnsbury, Vt., has resigned after 9 years of service. Previous to his association with the Fairbanks company, he was manager of foundries for the Singer Mfg. Co., Elizabeth, N. J., for 10 years.

Leon Kroll, former metallurgist, Joshua Hendy Iron Works, Sunnyvale, Calif., is now research metallurgist with the Dallas Copper & Brass Co., Chicago. Previous to his association with the Hendy company, Mr. Kroll was chief metallurgist for the Swiss Rolling Mills, Dornach, Switzerland.

Wallace W. Boone, formerly research chemist, American Radiator Co., Detroit, recently has been appointed chief chemist by the Rheinstrom Bros. Co., Cincinnati. Mr. Boone was born in Cincinnati on Nov. 4, 1894. He was educated in the public schools of that city and received a degree of chemical engineer from the University of Cincinnati. During the war he was metallurgist for the United States government at the Whitaker-Glessner Steel Co., Portsmouth, O. At the close of the war he assumed charge of the laboratory of the Peter's Cartridge Co., Kings Mills, O. Later Mr. Boone was assistant professor of chemical engineering and metallurgy at the University of Cincinnati for 5 years, after which period he joined the American Radiator Co.

C. D. Carey, works manager of the Verona, Pa., plant of the American Steel Foundries, Chicago, who was elected president of the Pittsburgh Foundrymen's association to succeed Lawrence V. Stevens, of the Locomotive Stoker Co., Pittsburgh, was graduated from Princeton university with the class of 1908 and from Massachusetts Institute of Technology, mechanical engineer, in 1910. For one year following he was affiliated with Dr. P. H. Dudley, consulting engineer of the New York Central railroad and then spent three years in the metallurgical and sales department of the Bethlehem Steel Co. After a year with the bureau of standards at Washington, as engineer physicist, he was employed for three years as chief inspector with Robert W. Hunt & Co., engineers. For the past nine years, he has been employed as assistant to the president of the Verona Steel Castings Co., Verona, Pa., which recently was taken over by the American Steel Foundries, Chicago. At present he is works manager at the Verona plant of the American Steel Foundries.

C. D. CAREY

Becomes President

George H. Thomson, formerly connected with the Swartwout Co., Cleveland, has resigned to become president of the Stanton-Thomson Corp., an organization formed to manufacture and sell a new type of heating element for core, mold drying and baking oven service. Offices of the new company are located at 75 West street, New York.

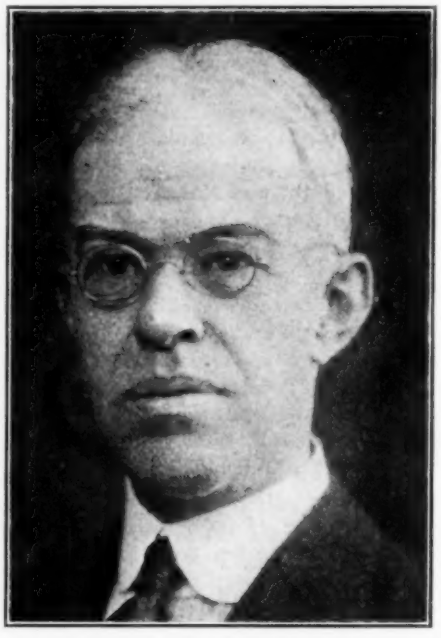
H. C. Cornelison, manager of the Miami, Fla., office of the Austin Co., Cleveland, engineers and builders, has been placed in charge of the firm's newly established office at Cincinnati.

Re-elected President of French Association

At the annual meeting of the Association Technique de Fonderie which recently took place in Paris the members of the council unanimously requested Leon Thomas to retain the office of president of the association for the year 1927-28. M. Thomas who recently completed a business tour of America, has accepted. The vice presidents remain as for last year, M. Damour being first vice president, assisted by MM. Derdinger, Magdelenat, Ronceray, J. Cury and Sandre, with Leon Brasseur as vice president for Luxemburg, M. Espana as vice president for Spain, M. Ropsy as vice president for Belgium and M. Vanzetti as vice president for Italy. The president of honor of the association is Emile Ramas. President Thomas has just returned to France from a tour in the United States. Among the vice presidents, MM. Magdelenat, Ronceray, Ropsy and Vanzetti attended the second international foundrymen's congress in Detroit last year, and MM. Coqueugnot and Montupet, members of the council of the French association, also were present at Detroit.

Donates Welding Award

At the annual dinner of the American Welding society held recently in New York, F. M. Farmer, president, announced the donation of an award, the gift of Samuel Wylie Miller, to be presented by the society annually in appreciation of work of outstanding merit in advancing the art and science of welding. The award is



SAMUEL W. MILLER

a gold medal which will be known as the Miller medal.

Mr. Miller has been one of the outstanding figures in the advancement of welding. He is a past president of the American Welding society, a member of the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers and other scientific and engineering organizations. He is consulting engineer, Union Carbide & Research Laboratories, Inc., Long Island, N. Y.

Extend Invitation To International Meet

An invitation to the Third International Foundrymen's congress, to be held in London, May 28 to June 1, 1929, has been forwarded to the American Foundrymen's association by the Institute of British Foundrymen. All of the foundrymen's associations in Europe have agreed on a program for future congresses. These will be held as heretofore at intervals of three years in rotation commencing with Great Britain in 1929, followed by Germany in 1932, France in 1935 and the United States in 1938.

Made General Manager

Robert T. Kent, until recently superintendent of prison industries, State of New York, has been appointed general manager of the Bridgeport Brass Co., Bridgeport, Conn.

Foundry Association Directory

American Foundrymen's Association

President, S. W. UTLEY, Detroit Steel Casting Co., Detroit; secretary-treasurer, C. E. HOYT, 140 South Dearborn street, Chicago; technical secretary, R. E. KENNEDY, 909 W. California street, Urbana, Ill.

The Buffalo Foundrymen
Buffalo

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 146 Chandler street. Meetings the third Wednesday of the month at 146 Chandler street.

Chicago Foundrymen's Club
Chicago

President, G. H. ROLINSON, American Brake Shoe & Foundry Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 W. Eighteenth street. Meetings second Saturday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, FRED W. STICKLE, Capitol Foundry Co., Hartford, Conn.; secretary, C. S. NEUMANN, Union Mfg. Co., New Britain, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association
Detroit

President, ROBERT G. CRAWFORD, Atlas Foundry Co., 131 Artillery street, Detroit; secretary, RUSSELL M. SCOTT, Packard Motor Co., 1580 East Grand boulevard, Detroit. Meetings third Thursday in each month at the Union League club, 35 Grand River avenue, Detroit.

East Bay Foundrymen's Association
Oakland, Calif.

Secretary, H. L. MARTIN, Marchant's Foundry Co., 4401 East Tenth street, Oakland, Calif.

Metropolitan Brass Founders' Association
New York

President, WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 34 West Thirty-third street, New York.

Newark Foundrymen's Association
Newark, N. J.

President, J. L. CARTER, Barlow Foundry Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President, HENRY S. CHAFEE, Builders Iron Foundry, Providence, R. I.; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio State Foundrymen's Association

President, WALTER L. SEELBACH, Walworth Run Foundry Co., 2488 West Twenty-seventh street, Cleveland; secretary-manager, ARTHUR J. TUSCANY, 5713 Euclid avenue, Cleveland.

Philadelphia's Foundrymen's Association
Philadelphia

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary HOWARD EVANS, Union League club, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Southern Metal Trades Association
Atlanta, Ga.

President, GEORGE B. COCKER, Gastonia, N. C.; secretary, W. E. DUNN JR., Healy building, Atlanta, Ga.

Pittsburgh Foundrymen's Association
Pittsburgh

President, C. D. CAREY, American Steel Foundries, Pittsburgh; secretary-trensurer, WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt Hotel.

Quad-City Foundrymen's Association
Davenport, Iowa

President, J. H. DIEDRICH, Blackhawk Foundry & Machine Co., Davenport, Iowa; secretary-treasurer, A. D. ZIEBARTH, Davenport Foundry & Machine Co., Davenport, Iowa. Meetings the third Monday evening of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Tri-City Technical Council
Moline, Ill.

Chairman, H. BORNSTEIN, Deere & Co., Moline, Ill.; treasurer, MAX SKLOVSKY, Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association
Cincinnati

President, HAROLD P. RITTER, John A. Oberhelman Foundry Co., 3323 Colerain avenue; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association
Minneapolis-St. Paul

President, H. H. NOTT, Smith System Heating Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meetings monthly at the Athletic club.

Obituary

Clarence Knight Prince, prominent in the foundry industry of New England for 25 years, and general superintendent, H. B. Smith Co., Westfield, Mass., manufacturer of boilers and radiators, died recently following an operation for appendicitis. Mr. Prince was graduated from Worcester Institute of Technology, Worcester, Mass., in 1892. He secured employment with the Smith company and advanced steadily. In 1917 he was appointed general superintendent. Since that time he was appointed to the board of directors of the firm and at the time of his death was a member of the executive committee of the board. Mr. Prince in addition to being general superintendent was director of production and general purchasing agent. He designed much foundry equipment and invented several automatic molding methods. Mr. Prince was 58 years old and is survived by his widow and two sons.

George W. Childs died suddenly in Hagerstown, Md., on May 14. For several years Mr. Childs was connected with the United States government at Washington, the American Steel Foundries, Chester, Pa., the New York Central Iron Works, and the Pangborn Corp., Hagerstown, Md. At various times he contributed articles on the foundry industry to the technical press. Mr. Childs was a member of the American Society of Mechnical Engineers.

Warren S. Abel, purchasing agent, Yale & Towne Mfg. Co., Stamford, Conn., died at his home in that city on May 14 at the age of 63 years. Mr. Abel had been purchasing agent of the firm since 1898.

Eugene Panneton, founder of the Canada Stove & Foundry Co., died in Montreal, Que., April 26, aged 58 years. He was general manager of the Canada Stove company until it became merged with the Gurney Foundry Co., Toronto. He subsequently became managing director of the Beeby Thermos Ranges Ltd. and occupied this position at his death.

George Gerry White, secretary of the Phoenix Iron Co., Philadelphia, and for 57 years affiliated with that organization died April 26 at the age of 87.

Andrew Wickey whose death at 80 years was announced in the May 1 issue of THE FOUNDRY, was head of the Famous Mfg. Co., East Chicago, Ind., and not president of the Calumet Foundry & Machine Co., that city, as formerly stated.

Edward B. Manley, aged 56 years, founder of the Manley Sand Co., died April 21 at his home in Rockton, Ill., following a short illness.

Charles H. McKenna, aged 54 years, president, McKenna Bros. Brass Co., Pittsburgh, died May 9 at his home in Crafton, Pa. He was a director of the Duquesne National bank, International Oil & Gas Co., vice president and director of the McKenna Brass & Mfg. Co.; president and director of the McKenna Investment Co.; vice president and director of the McKenna Horix Mfg. Co., and a director of the Vanadium Alloys & Steel Co.

Benjamin Atherton Hawley, vice president, American Hardware Corp.,

CLARENCE K. PRINCE

and general manager of the Russell & Erwin division of that corporation, New Britain, Conn., died May 11 at his home in that city. He was 59 years old. Mr. Hawley entered the employ of the Russell & Erwin Mfg. Co., soon after his graduation from Williston academy, East Hampton, Mass., and occupied nearly every position in his advance to manager. About 25 years ago he was transferred from New York to the New Britain office. In 1907 he was elected a director of the American Hardware Corp. and later was elected vice president.

Joins Quigley Company

Harrison W. Wood has joined the service staff of the Quigley Furnace Specialties Co., Inc., New York. He will have his headquarters in Atlanta, Ga., and cover the South Central and South Atlantic states.

Present Bessemer Medals

At the annual meeting of the Iron and Steel institute held in London May 5 and 6, Axel Wahlberg and Prof. Benedicks, both of Sweden, were presented with the Bessemer gold medals. Mr. Wahlberg was presented with a medal for his work on steel in the practical field and Prof. Benedicks for his work in the metallurgical field. Following the reading of the annual report Sir Peter Rylands inducted the new president of the institute, Frank W. Harbord, who took the chair. Numerous papers on the various phases of the iron and steel industry were presented at the technical sessions held on May 6.

Appointed Manager

Ross L. McLellan, formerly managing director, Cia. Westinghouse Electric Internacional, S. A., has been appointed general manager of the Westinghouse Electric International Co., with headquarters in New York. Mr. McLellan was graduated from Purdue university, Lafayette, Ind., in 1907 and joined the Westinghouse staff in 1915. He went to Santiago, Chile in 1921 and represented the firm in Brazil in 1922. In 1923 he was sent to Europe in connection with railway electrification. Mr. McLellan was made managing director of the Cia. Westinghouse Internacional, a subsidiary of the Westinghouse Electric International, operating in Argentine, Uruguay and Paraguay with headquarters in Buenos Aires.

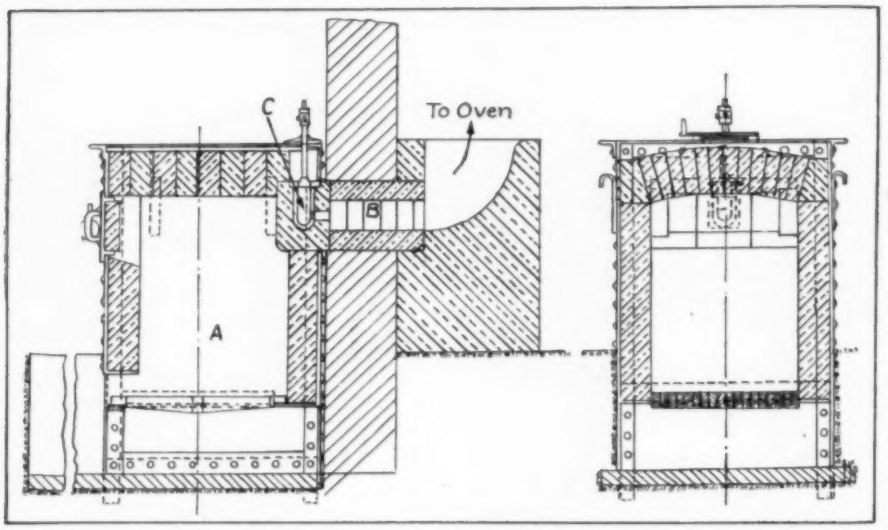
Brass Interests Merge

Consolidation of three large Detroit brass companies to be known as the General Brass Corp. has been effected. Companies involved are the McRae & Roberts Co., the Michigan Lubricator Co. and the Standard-Penisular Brass Works. The combined output of products will include gas-stove cocks, radiator valves, plumbing goods, automobile parts and a comprehensive line of brass and metal goods. Officers of the new firm will be W. S. Killam, McRae & Roberts Co., president; Elwood C. Johnston, Michigan Lubricator Co., first vice president; W. S. Chillman, McRae & Roberts Co., second vice president; M. E. Czarnowski, McRae & Roberts Co., treasurer; Philip E. Welton, Standard-Peninsular Brass Works, secretary.

The New Jersey Foundry & Machine Co., builder of cranes and other foundry equipment, has removed its New York office to the Park-Murray building, 915 Park place.

Heating Element Has Two Combustion Chambers

The Stanton-Thomson Corp., New York, recently organized, has taken over the manufacturing and selling rights of a special heating element designed by Mr. Oehm in Germany. This unit, which is applicable particularly to drying molds and cores on the floor or in pits and for attachment to mold and core ovens already installed, uses coke as a fuel. The apparatus has as its principle of operation the induction of primary air through the fire bed of an ordinary combustion chamber by a compressed air jet fitted into the secondary chamber. The primary products of combustion, namely carbon monoxide carrying gases, are sucked into the specially designed secondary combustion chamber where combustion is completed with the air delivered by the jet. The air jet automatically controls the combustion of solid fuel placed in the primary chamber. The result of the double combustion, it is claimed, is the delivery of dry, hot, inert gas at a considerable velocity at the discharge point of the heating element.



PRIMARY COMBUSTION TAKES PLACE IN CHAMBER *A* AND THE GASES ARE COMPLETELY BURNED IN CHAMBER *B* WITH THE AID OF AIR FROM JET *C*

Sectional views of the unit designed for application to mold and core ovens are shown in the accompanying illustration. As may be seen, the apparatus consists of an iron plate, firebrick lined structure containing two compartments, which are shown at *A* and *B*. The one shown at *A* forms the primary combustion chamber and is fitted with grate bars at the bottom and a charging door at the side. Air enters the compartment only between the bars and through the bed of coke. The necessary draft is caused by the jet of air which enters the secondary combustion compartment *B* at *C*. Air at a pressure of 70 to 80 pounds per square inch is employed. The air is preheated by passing through a coil of tube carried along the side of the firebrick wall of the chamber *B*. The secondary chamber has a system of louvred firebricks.

One of the features claimed for the apparatus is the fact that the temperature in the oven is maintained uniform by having the heating gases enter the chamber under a slight positive pressure. A damper control at the exhaust points is regulated for this purpose. The apparatus is designed so that temperature control of the drying gases is simple in operation and where high temperatures are required it is possible to deliver the inert gas from the element as high as 3000 degrees Fahr. The unit is designed to operate on the cheapest available fuel. Coke screenings and breeze are satisfactory. The amount of air used is practically negligible as not more than 20 cubic feet per minute of free air is used per jet. Normally there is one jet to an element and one element to an oven. The apparatus also is made in a portable type which is used to dry molds on the floor.

Sells Foundry Specialty

Announcement is made that C. E. McArthur & Co., 1553 West Madison street, Chicago, has disposed of its rod straightening business to the American Foundry Equipment Co., Mishawaka, Ind. The McArthur company, however, still retains its other production work. The company will center more activity in the future on manufacturing a hydraulic brake. The present personnel of the McArthur company will be retained.

NewEnglandFoundrymen Hold Meeting

At the regular monthly meeting of the New England Foundrymen's association held at the Exchange club, Boston, on May 11, R. F. Harrington, metallurgist, Hunt-Spiller Mfg. Corp., Boston, discussed the application of clay bond to foundry molding sand heaps.

Officers Are Re-elected

At the annual meeting of the Timken Roller Bearing Co., Canton, O., which was held recently, the present officers were re-elected. Officers of the firm follow: H. H. Timken, president; W. R. Timken, John G. Obermier, M. T. Lathrop, H. J. Porter and T. V. Buckwalter, vice presidents; J. F. Strough, secretary and treasurer; and W. A. Brocks, assistant treasurer. Directors are: H. H. Timken, W. R. Timken, M. T. Lathrop, J. G. Obermier and J. F. Strough.

Make Welding Film

Gas Products association, 140 South Dearborn street, Chicago, the membership of which is composed of manufacturers of oxygen, acetylene, hydrogen, and welding and cutting apparatus, recently has completed two reels of film showing industrial application of welding and cutting. A limited number of these films are available for organizations desiring to exhibit them. Further information may be obtained from Stuart Plumley, secretary of the association.

Is Purchasing Agent

F. G. Syburg, for the past several years connected with the export department of the Chain Belt Co., Milwaukee, recently has been promoted to purchasing agent. He began with the firm as student engineer in 1919 and has worked in practically all departments. In 1921 he was placed in charge of the concrete mixer production and in January, 1924, entered the export department. Recently Mr. Syburg completed a 14-months' tour of New Zealand, Australia, India, Java and other foreign countries on business. E. P. Hubbard, formerly in the concrete mixer department, will succeed Mr. Syburg in the export department.

V. J. Rohe, 101 East Tremont avenue, New York, has been appointed district representative for its steel flasks by the Shanafelt Mfg. Co., Canton, O.

Buyers Show Slight Hesitancy

Spotty Condition of Foundry Industry Is Reflected in Purchases of Equipment—Report Shows April Sales Under March Total

FOUNDRY equipment appears to be moving a trifle slower in most sections of the country, due perhaps to the spotty condition existing in the foundry industry generally. Sales in the Cleveland territory have fallen slightly in some lines although numerous promising inquiries are current which indicate possible substantial business in the near future.

While inquiries are fairly numerous in the Eastern territory, orders are coming through slowly. This condition probably reflects the slower operating conditions in the district and the lack of any extensive construction work. Improvement in car and locomotive buying recently may tend to bolster up foundry equipment buying.

Sales for the current year in the Chicago district are somewhat in advance of the corresponding period a year ago, but the advance is tapering off. May business was slightly under the total registered in April. Most purchases are for improvements in operating plants as few new construction projects are appearing.

Sellers of equipment in the vicinity of Pittsburgh are encountering considerable hesitancy on the part of buyers. Some attribute most of this to the doubt cast over industry in general by the overhanging coal strike. While no suffering for coal is noted, still the doubt as to the length of the strike and the final outcome acts as a deterrent in the matter of expending money for equipment. Two or three core ovens are under inquiry and a number of cupolas are being considered. Interest also is noted in equipment for preparing sand.

Business in New England during the last of May was spotty. A tendency is noted among jobbing foundries to buy only for immediate needs. Several manufacturers of special lines have been expanding and have bought conveyor equipment and molding machines. Buying is particularly active in the Springfield, Mass., district where a new foundry has been placed in operation and several establishments are working overtime.

Exports of foundry and molding equipment in March totaled $57,648 as compared with $61,382 in February.

Sales of foundry equipment in April, as reported by 18 manufacturers to the Foundry Equipment Manufacturers association, Cleveland, totaled $478,273 as compared with $508,531 in March and $469,608 in April, 1926. The total sales for the first four months of 1927 were $2,331,057 as compared with $2,156,527 during the corresponding period in 1926, a gain of 8 per cent. Shipments for April were $601,808 as against $603,735 in March and $451,573 in April a year ago. Orders on hand declined from $995,075 on April 1 to $838,752 on May 1.

PITTSBURGH MARKET

Cranes

National Radiator Co., Johnstown, Pa., one 1½-ton crane from H. D. Conkey & Co., Chicago.

Ladles

Wheeling Mold & Foundry Co., Wheeling, W. Va., 8-ton ladle; Westinghouse Airbrake Co., Wilmerding, Pa., small helical worm geared ladles from the Whiting Corp., Harvey, Ill.

Sand Preparing Equipment

Frog Switch & Mfg. Co., Carlisle, Pa., sand separator and blender from the J. S. McCormick Co., Pittsburgh.

Standard Sanitary Mfg. Co., New Brighton, Pa., sand sifting machine from the J. S. McCormick Co., Pittsburgh.

National Radiator Co., New Castle, Pa., sand mixing machine and special screening equipment; Wheeling Mold & Foundry Co., Wheeling, W. Va., mixing machine from the Standard Sand & Machine Co., Cleveland.

Shakeout Equipment

Pittsburgh Plate Glass Co., Creighton, Pa., Richmond Radiator Co., Uniontown, Pa., vibrator and shakeout equipment from the Stoney Foundry Engineering & Equipment Co., Cleveland.

NEW ENGLAND MARKET

Furnaces

Commonwealth of Massachusetts for state prison foundry, Charlestown, Mass., one cupola from the Northern Engineering Works, Detroit, through W. Scott Thomas, Providence, R. I.

J. H. Williams Co., Millbury, Mass., furnaces, tumbling barrel and other equipment through W. Scott Thomas, Providence, R. I.

Ladles

Henry Perkins Co., Bridgewater, Mass., geared reservoir ladle from the Northern Engineering Works, Detroit, through W. Scott Thomas, Providence, R. I.

General Electric Co., West Lynn, Mass., one 7-ton and one 10-ton helical worm geared ladles from the Whiting Corp., Harvey, Ill.

Sand Preparing Equipment

James Hunter Machine Co., North Adams, Mass., sand separator and blender from the Royer Foundry & Machine Co., Wilkes-Barre, Pa., through Alexander Haigh, Boston.

Shakeout Equipment

Gurney Heater Co., Framingham, Mass., shakeout bails from the Stoney Foundry Engineering & Equipment Co., Cleveland.

NEW YORK MARKET

Furnaces

Stanley G. Flagg Co., Philadelphia, two structural type cupolas from the Whiting Corp., Harvey, Ill.

Shakeout Equipment

U. S. Radiator Co., Geneva, N. Y., vibrator and shakeout equipment from the Stoney Foundry Engineering & Equipment Co., Cleveland.

CHICAGO MARKET

Furnaces

Boykins Machinery & Supply Co., Beaumont, Texas, one cupola; Nutting Truck Co., Faribault, Minn., one cupola; from the Whiting Corp., Harvey, Ill.

Ladles

Southern Wheel Co., Hammond, Ind., two 12-ton motor operated ladles from the Whiting Corp., Harvey, Ill.

Molding Machines

Lakey Foundry & Machine Co., Muskegon, Mich., four jolt-squeeze-strip machines from the Stoney Foundry Engineering & Equipment Co., Cleveland.

Sand Preparing Equipment

Snyder Foundry Supply Co., Huntington Park, Calif.; sand mixer from the Standard Sand & Machine Co., Cleveland.

Ypsilanti Motor Castings Co., Ypsilanti, Mich., sand separator and blender from the Royer Foundry & Machine Co., Wilkes-Barre, Pa., through Alexander Haigh, Boston.

Frank Foundries Corp., Moline, Ill.; Saal Brothers, Rockford, Ill., sand separator and blender from the Royer Foundry & Machine Co., Wilkes-Barre, Pa., through Page & Ludwick, Chicago.

Shakeout Equipment

National Malleable & Steel Castings Co., Chicago, shakeout bails; Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich.; Weil-McLain Co., Michigan City, Ind.; Griffin Wheel Co., Council Bluffs, Iowa; Holland Furnace Co., Cedar Rapids, Iowa; Holland Furnace Co., Holland, Mich., vibrator and shakeout equipment from the Stoney Foundry Engineering & Equipment Co., Cleveland.

Buick Motor Car Co., Flint, Mich., three core knockout machines from the Stoney Foundry Engineering & Equipment Co., Cleveland.

Tumbling Barrels

Lennox Furnace Co., Marshalltown, Iowa, two; Western Harvester Co., Stockton, Calif., two; from the Whiting Corp., Harvey, Ill.

CLEVELAND MARKET

Furnaces

Grabler Mfg. Co., Cleveland, one cupola from the Whiting Corp., Harvey, Ill.

Ladles

Pratt & Letchworth Co., Buffalo, two bottom pour ladles from the Whiting Corp., Harvey, Ill.

Molding Machines

Ferro Machine & Foundry Co., Cleveland, 18 jolt-squeeze-strip machines and 15 core machines from the Stoney Foundry Engineering & Equipment Co., Cleveland.

Sand Preparing Equipment

Hamilton Foundry & Machine Co., Hamil-

ton, O.; New Foundry Appliance Co., Trenton, O., sand separators and blenders from the J. S. McCormick Co., Pittsburgh.

Chandler & Price Co., Cleveland, sand mixers from the Standard Sand & Machine Co., Cleveland.

Shakeout Equipment

Fox Furnace Co., Elyria, O.; the International Harvester Co., Hamilton, Ont.; the Henry Furnace & Foundry Co., Medina, O., one each; the Pullman Car & Mfg. Co., New Orleans, La., two; the Ferro Machine & Foundry Co., Cleveland, six; shakeout bails from the Stoney Foundry Engineering & Equipment Co., Cleveland.

Fremont Foundry Co., Fremont, O.; Holmes Foundry Co., Port Huron, Mich.; Ohio Steel Foundry Co., Lima, O. vibrator and shakeout equipment from the Stoney Foundry Engineering & Equipment Co., Cleveland.

Ferro Machine & Foundry Co., Cleveland, five core knockout machines from the Stoney Foundry Engineering & Equipment Co., Cleveland.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Onley Foundry Co., 180 West Duncannon street, Philadelphia, will start work at once on the erection of a $20,000 plant addition.

Western Brass Inc., Seattle, has been incorporated with $40,000 capital by A. L. Hullin, E. A. Hullin and W. R. Cranston.

Worthington Pump & Machinery Corp., 37 Appleton street, Holyoke, Mass., is building an addition to its machine and erecting shops.

Roberts & Mander Stove Co., Hatboro, Pa., has let contract to the Cameron Engineering Co. for a brick and steel plant to cost $140,000.

Smithlie Castings Corp., Buffalo, has been incorporated with $250,000 capital by A. W. Plumley, Buffalo.

Lavelle Foundry Co., Anderson, Ind., Jefferson street plant was damaged by fire recently, necessitating a three weeks shutdown.

Weber Brass Co., Cleveland will erect a new factory at Emerald court North East and East Twelfth street.

Armstrong Mfg. Co., Springfield, O., manufacturer of stokers and other heavy equipment, is rebuilding its burned foundry.

Service Foundry Co., Cleveland, has been incorporated with $25,000 capital by J. W. Askins and Charles F. Sipher.

Deere & Co., Harvester Works, 504 Third avenue, East Moline, Ill., will build a 1-story factory.

American Steel Foundries, Alliance, O., is having plans made for a 2-story addition to its plant 60 x 80 feet.

J. W. Hoopes, Denbigh, Va., plans to establish a machine shop and foundry business for the production of brass and iron castings and finishings.

Acme Pattern Works, 495 Fifty-sixth avenue, West Allis, Wis., has awarded the contract for a 1-story manufacturing addition, 80 x 150 feet.

A. & P. Foundry Co., Wiser avenue, Worcester, Mass., manufacturer of gray iron castings, will start operations in its new plant shortly.

Robey Foundry Co., Chicago, is building an office building and stock room which is to be completed and ready for occupancy June 1.

Enterprise Foundry Co., 2903 Nineteenth street, San Francisco, has had plans made for the first units of a plant on its new site in the inner harbor district at Richmond, Calif.

Lancaster Malleables & Steel Corp., Lancaster, N. Y., has been incorporated with $250,000 capital by Davis, Symmes & Schreiber, 14 Wall street, New York.

Peninsular Stove Co., Detroit, has broken ground for its new plant which will have a 2-story administration and factory building 256 x 800 feet.

Western Machinery Co., Los Angeles, will build a 1-story foundry. General contract has been let to the Union Iron Works, 5125 Santa Fe avenue.

Paul Roberts Machine Shop, Pocatello, Idaho, has purchased property and will remodel the building it acquired. A foundry will be erected within a year, it is planned.

A. P. Smith Mfg. Co., 275 North Arlington street, East Orange, N. J., manufacturer of waterworks equipment, will build a 3-story plant addition 45 x 70 feet.

Smith & Watson Iron Works, Portland, Oreg., wil remodel its plant to give more room for the manufacture of paper mill machinery.

Hopper Machine Works, Bakersfield, Calif., plans to build a foundry and machine shop to specialize in the production of oil well machinery.

A. B. C. Boiler Corp., 342 Madison avenue, New York, has been organized to manufacture cast iron steam and hotwater boilers. A plant is being established at Poughkeepsie, N. Y.

Kiowa Foundry Co., Marshalltown, Iowa, R. C. McCagge, secretary, Chamber of Commerce building, has let general contract to C. F. Reimer Co. for a 1-story foundry plant on South 126th street.

Fellows Brass & Iron Foundry, Waterville, Me., has been incorporated with $10,000 capital to engage in the general foundry and machine shop business, by Frank C. Fellows, Brookline, Mass.

Stege-Jackson Brass & Plating Works, Louisville, Ky., has been incorporated with $8000 capital by Louis C. Stege, 1442 South Lloyd street, H. C. Jenkins and G. C. Jenkins, 4722 Taylor boulevard.

Interstate Foundry & Machine Co., Longview, Wash., will begin operations this month. Machinery and equipment are arriving. The plant will manufacture catsings and also conduct a pattern shop. (Noted March 15.)

Boyertown Brass Foundry Co.'s former plant at Boyertown, Pa., has been taken over by the Boyertown Steel Products Co. which is installing equipment for the production of seamless steel couplings.

Chapman Valve Mfg. Co., Indian Orchard, Mass., has completed two additions to its plant. One addition is a machine shop 140 x 300 feet. The other is an electric steel foundry.

Peerless Valve Mfg. Co., 1302 North Halsted street, Chicago, has been incorporated with $40,000 capital to manufacture valves, plumbing fixtures, pipe and metal goods, by F. O. Fitzpatrick, A. H. Witt and Edwin J. Nunn, 105 West Monroe street.

Texas Electric Steel Casting Co., Houston, Tex., F. A. Kroll, president and manager, 1515 Spring street, will build an addition to its foundry plant, including electric crane, electric furnace, sandblast and compressors.

The Greenlee Foundry Co., Fourteenth street and South Kenton avenue, Chicago, was damaged by fire May 17. The office and pattern department were damaged considerably, but the remainder of the plant was undamaged and operations are continuing.

Municipal Foundries Inc., West Allis, Wis., has completed its plant and begun production of castings for municipal purposes. P. E. Hanson is president and general manager, L. T. Zimmerman, secretary and treasurer, and T. Zimmerman, vice president. (Noted April 1.)

Pullman Car & Mfg. Co., Chicago, has completed plans to construct a $500,000 foundry in New Orleans for the manufacture of chilled car wheels. Production is scheduled to start in the fall. Buildings will be located on a site recently purchased in Jefferson parish, just outside the city limits.

Haines, Jones & Cadbury Co., Philadelphia; Krupp Foundry Co., Lansdale, Pa., and the Bridgman Co., Philadelphia, have been merged and will operate under the name of the Hajoca Corp. J. Harvey Borton, president, Haines, Jones company has been elected president of the new corporation.

A new jobbing foundry is to be started in Springfield, Mass., by Arthur J. Britton and John Corridon. Mr. Britton has been vice president and general manager of the Holyoke Foundry Co., for the past 7 years. John Corridon has been connected with the Davitt Foundry Co., Springfield, Mass., for 16 years. The firm has been incorporated with $10,000 capital under the name of the Springfield Castings Co. Inc., and will do a general foundry and machine shop business.

Fire severely damaged the H. R. Gibbons Co. plant at Iowa street and Kilpatrick avenue, Chicago, on the morning of May 13. This plant for many years was occupied by the Reedy foundry, and had been equipped for foundry purposes. Several years ago the plant had been taken over by a core oil concern, and later was occupied by the Gibbons company.

New Trade Publications

PULVERIZERS—Raymond Bros. Impact Pulverizer Co., Chicago, has issued a catalog describing its automatic pulverizers with air separation. These machines are manufactured in several sizes and may be used in grinding various materials.

HOISTS—Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., is circulating a bulletin covering its various types of lifting devices where power is enabled to do the work of several men. It is illustrated.

CONVEYORS—Alvey Mfg. Co., St. Louis, has issued a circular calling attention to advantages of its conveyors for moving material, as compared with man-power. Typical insfallations for various uses are shown.